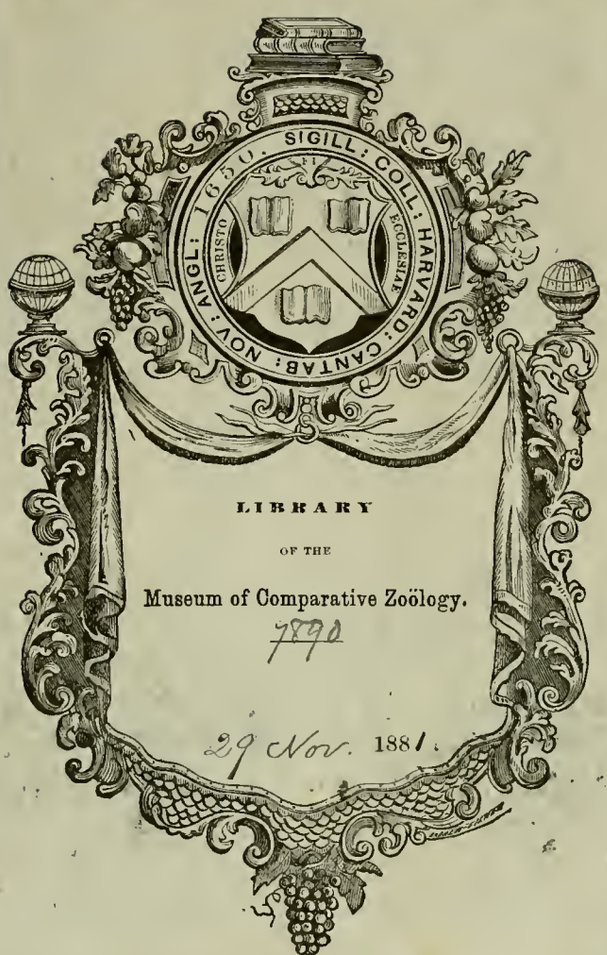
BRITISH FRESH-WATER FISHES



By

THE REV. W. HOUGHTON.

M.A., F.L.S.



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British Fresh-water Fishes.

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BRITISH

FRESH-WATER FISHES

BY

THE REV. W. HOUGHTON, M.A., F.L.S.,

RECTOR OF PRESTON-ON-THE-WEALD MOORS, SHROPSHIRE.

Author of "Sea-side Walks of a Naturalist," &c.

ILLUSTRATED WITH

A COLOURED FIGURE OF EACH SPECIES DRAWN FROM NATURE BY A. F. LYDON,

AND NUMEROUS ENGRAVINGS.

LONDON:

WILLIAM MACKENZIE, 69, LUDGATE HILL. E.C.

EDINBURGH AND DUBLIN.

TO MY LONG-KNOWN AND HIGHLY-VALUED FRIEND

PROFESSOR GEORGE BUSK, F.R.S., F.L.S., &c., &c.,

ONE OF THE MOST EMINENT OF NATURALISTS

AND MOST GENEROUS OF MEN,

I DEDICATE THIS WORK.

PREFACE.

IT is hoped that this Work on the Fresh-water Fishes of the British Isles will be found acceptable, and prove generally useful. A description and a coloured drawing of every fresh-water species will, it is believed, enable any one to identify any fish that may be met with. Several species of *Salmonidæ* are now here for the first time illustrated by coloured drawings; the illustrations, in every case where possible, having been made from specimens of the fish themselves.

It only remains for me to express my thanks to those gentlemen who have rendered me assistance in procuring specimens, or otherwise helping me. I must especially thank Dr. A. Günther, of the British Museum—the highest living ichthyological authority*—for permission to make use of the Plates in *The Proceedings of the Zoological Society of London*, (1862, 1863, 1865,) illustrating his papers on the British species of Charr; I have also to thank the Council of that Society for granting me the same permission. I have been fortunate enough to see and handle all the British Charrs, and specimens of all the species have been before the artist engaged in this work, but the Plates above named were found most useful in giving the characteristic colouration which specimens some days out of the water, or specimens preserved in spirits, almost invariably lose. I have also, through the kindness of Dr. Günther, had opportunities of examining specimens of various fish in the British Museum; and the artist has been able to take figures of some species which are either rare, or which I failed to procure for myself.

To Mr. Masefield, of Ellerton Hall, Shropshire, a most successful pisciculturist, I am indebted for specimens of several species, one of the most interesting of which is the Golden Tench. I have also to express my thanks to my brother-in-law, Lieutenant-Colonel Masefield, and to my brother, Major Henry Houghton, for assistance and information. I am greatly obliged to Mr. Thomas Brooke, of the Castle, Lough Esk, and to Mr. Arthur R. Wallace, of Dublin, for several specimens of that very local species, Cole's Charr *(Salmo colii)*. I owe many thanks to Mr. Alexander Scott, of the Garrison Hotel, Lough Melvin, for specimens of Gray's Charr *(S. grayi)*, and the Great Lake Trout *(S. ferox)*. To Mr.

* In acknowledgment of Dr. Günther's services the Council of the Royal Society has lately presented this distinguished Naturalist with one of their medals.

John Parnaby, of Troutdale, Keswick, Cumberland, I am indebted for specimens of Windermere Charr, and of the American Trout, *(Salmo fontinalis)*. To Mr. T. J. Moore, the ever obliging Curator of the Liverpool Museum, I owe many thanks for opportunities of examining the fresh-water fishes in that collection; especially for some specimens of the so-called Azurine, taken many years ago from some of the ponds on the Earl of Derby's estate at Knowsley. Mr. Frank Buckland obligingly sent me a few specimens of the young of the Bull Trout of the Coquet; for several large specimens (male and female) of this fish I have to thank Sir Walter B. Riddell, Bart., of Hepple, Northumberland, and Mr. Pape, of Newcastle. Mr. William Dunbar has given me his opinion as to the Coquet Bull Trout, and his remarks will be found in their place. The Earl of Enniskillen was kind enough to write me a letter containing information which proved useful during my visit to Ireland in the summer of 1878. I must not forget to thank Mr. William Haynes, of Patrick Street, Cork, for specimens of the Galway Sea Trout, and for his opinion and experiences of the Slob or Tidal Trout of the Lee and Bandon rivers. To Mr. Charles Selby Bigge, one of the Conservators of the Dee Fishery Board, I must express my best thanks for assistance and information. Sir Watkin Williams Wynn, Bart., most kindly placed his little steam-launch, men, and nets at my disposal in Bala Lake, in September, 1878, for the purpose of procuring Gwyniad; I beg to express my best thanks to the worthy Baronet, as well as to Mr. Owen Wynne and Mr. Bigge, for accompanying me and superintending the fishing. Lastly, I have to thank the artist for the care he has bestowed on the drawings, which I think cannot fail to give satisfaction both as regards accuracy and artistic effect.

Although some additional knowledge on the subject of the British fresh-water fishes has been gained since the publication of the works of Yarrell and Couch,—excellent as those works are,—yet much remains at present obscure. It is not often we know the whole life-history of a fish; this is especially the case with many of the *Salmonidæ*. The solution of various questions relating to this exceedingly difficult family, can, I think, only be successfully made by persons trained more or less in scientific subjects, who have almost unlimited time and ample pecuniary resources at their command, and of course permission from the various Boards of Conservators throughout the country to take from time to time during the whole year, even with nets of very small meshes, such fish, whether small or large, as they may wish to examine. In this way it would be possible to clear away much of the obscurity that at present exists.

This book treats of the natural history of the various species of fishes that are known to occur in the rivers, lakes, and ponds of the British Isles; it is not intended to supply information as to the various modes of angling, whether trolling, spinning, bottom-fishing, fly-fishing, etc., adopted in this country. For such information the reader will find all, and perhaps even more than he wants, in the various numerous handbooks which have been published on this subject.

Preston-on-the-Weald Moors Rectory, Shropshire,
March 1st., 1879.

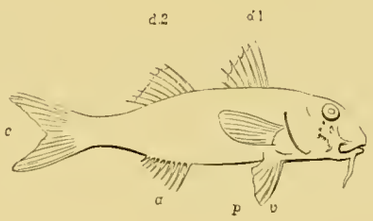
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INTRODUCTION.

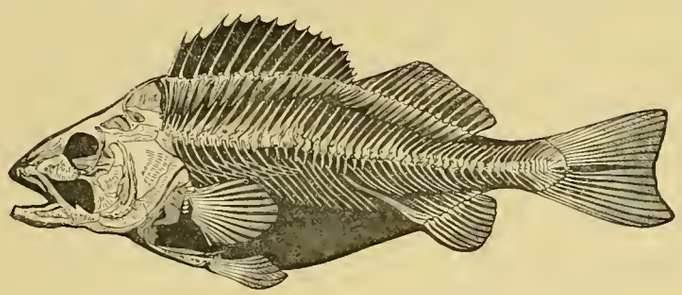
FISHES form the fourth class of vertebrate animals; they are provided either with gills (*branchiæ*), or gill-sacs (*marsipobranchiæ*), by means of which they are enabled to breathe the air contained in the water in which they live; the heart, which consists of a single auricle and ventricle, is present in almost all fish except in the sub-class *Leptocardii*, where certain pulsating sinuses perform the functions of a heart, as in the curious little marine fish the Lancelet *(Branchiostomi lanceolatum)*. The limbs in fishes, corresponding to those organs in other vertebrates, occur, when present, in the form of fins. These fins are generally arranged in pairs at the sides, when they represent the limbs of other vertebrata, or they may occur singly on the back and abdomen; the paired fins are the pectoral and the ventral; the dorsal, anal, and caudal fins are unpaired or asymmetrical.



The arrangement of the fins will be readily seen in the accompanying woodcut of the Bearded Mullet (*Mullus barbatus*), *d*1 is the first dorsal fin; *d*2 the second dorsal; *v* one of the paired ventrals; *p* one of the paired pectorals; *a* the anal fin, and *c* the caudal fin or tail. For the most part these fins are structurally similar; they consist of a fold of the skin, or expansions of the integument, and are supported by bony or cartilaginous rays, pretty much in the way, as Milne Edwards says, "that the wings of bats are supported by the fingers and ribs." The pectoral fins, which are analogous to the fore-limbs of other vertebrates, are attached by their base to a strong bony arch, which is itself fixed to the back of the skull, or to the anterior part of the spinal column; this arrangement may be readily seen by any one who carves a Cod's head and shoulders at dinner; the ventrals, or the hind-limbs of fishes, are fixed to an arch of bone—the representation of the pelvic arch of the higher vertebrates—which is sometimes merely supported by the muscles, in cases where these organs are placed far back as in the Pike, a complete skeleton of which is before me as I write; but where the ventral fins are situated not far back, but in the vicinity of the pectoral, the pelvic arch is united to the pectoral arch; the unpaired or *median* fins, as they are sometimes called, are strengthened by osseous or cartilaginous rays, and are supported upon "interspinous

bones" imbedded in the flesh of the fish; the points of the interspinous bones are attached to the spinous processes of the vertebræ, each by a ligament, their heads are firmly united to the bases of the fin rays; this arrangement between the median fins, the interspinous bones, and the vertebral spinous processes, may easily be seen by anyone, who will take the trouble to look out for it, when he is eating a fried Perch for breakfast or dinner.

The caudal fin or tail is the chief organ of motion in a fish; by a rapid succession of oblique lateral impulses the fish is enabled to dart through the water at a very quick pace. There are two distinct types of tail in fishes, one being much more common than the other: in one type this organ consists of two equal or nearly equal lobes, which are attached to the spinous processes of the posterior part of the vertebral column; as is the case in all the British fresh-water species of fish, with the exception of the Sturgeon. This symmetrical tail is said to be *homocercal;* from ομος, "the same," and κερκος, "the tail." The other type of tail, which occurs in the Sturgeon, Sharks, Dog-fishes, &c., exhibits an unsymmetrical form, for the lobes are unequal, while the vertebral column runs right into the upper portion of the tail; this structural arrangement is designated by the term *heterocercal;* from ετερος, "different," and κερκος, "the tail" (See this form of tail in the plate of the Sturgeon.)



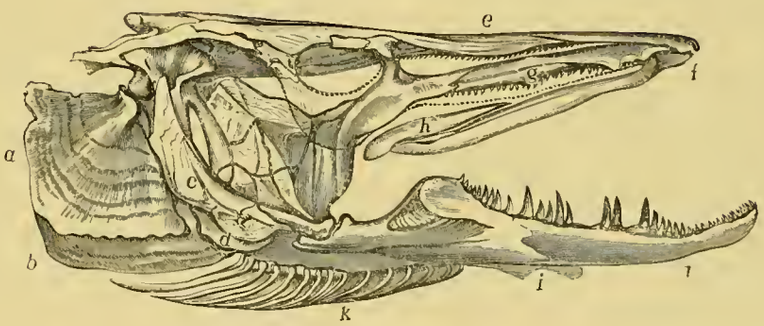
Skeleton of Perch.

The interspinous bones are seen between the vertebral column and the dorsal fins.

The skeleton is either osseous or cartilaginous. Most of the British fresh-water species have osseous skeletons, and belong to the sub-class TELEOSTEI; others, as the Lampreys, have cartilaginous skeletons throughout life; in some fishes, as in the Sturgeon, the skeleton is partly cartilaginous; in the Lancelet, a salt-water fish of the lowest type, there is no true skeleton, the vertebral column being merely a gelatinous notochord. The vertebra of a bony fish is cup-shaped at both ends, the margins being attached by ligaments. In the cavities formed by the junction of the vertebræ there is a quantity of jelly-like substance, imparting to the spine great flexibility: this lubricating gelatinous substance passes from one intervertebral cavity into another through minute pores which perforate their centres. The spinal column consists of two parts, an abdominal, and a caudal. The spinal cord passes through the upper or *neural* arch of the vertebræ for the whole length of the body of the fish: the abdominal vertebræ possess also a superior spinous process, and two transverse processes for the attachment of the ribs. In the caudal vertebræ there are no transverse processes, but this portion of the column possesses an inferior or *hæmal* arch, as well as inferior spinous processes.

The bones of a fish's skull are numerous, and the structure of the head is very complex; the cranium of osseous fishes, when its parts are complete, is made up of no fewer than twenty-six bones. In the median portion of the cranium there is a cavity which contains the brain and the auditory apparatus. The other parts necessary to be noticed for the discrimination of species are:—(1) The gill-cover, consisting of the operculum, præoperculum, suboperculum, and interoperculum. (2) The upper portion of the jaw, called the maxillary. (3) The præ-

or intermaxillary. (4) The palatine bones. (5) The vomer. (6) The hyoid bones. (7) The mandible or lower jaw. (8) The branchiostegal rays.



Head of Pike.

a, operculum. *b*, suboperculum. *c*, preoperculum. *d*, interoperculum. *e*, vomer. *f*, præmaxillary. *g*, palatine. *h*, maxillary. *i*, hyoid. *k*, branchiostegal rays hyoid. *l*, mandible.

Fish as a rule have their external integuments covered with scales, though there are fish quite destitute of scales; amongst the scaleless fresh-water fish may be mentioned the Miller's Thumb and the Lampreys. Important characters may sometimes be drawn from the form of the scales. Agassiz enumerates four kinds of scales, which he termed *cycloid*, *ctenoid*, *placoid*, and *ganoid*.

(1.) *Cycloid* scales (from κυκλος, "a circle,") are thin scales more or less circular, with a smooth margin; they occur in most of our fishes.

(2.) *Ctenoid* scales (from κτεις, κτενος, "a comb,") have their hinder margins cut into comb-like spines, as in the Perch.

(3.) *Placoid* scales (from πλαξ, πλακος, "anything flat and broad,") consist of detached bony plates scattered through the skin; these scales are not unfrequently armed with projecting spines, as in the common Thornback Ray.

(4.) *Ganoid* scales (from γανος, "brightness," "polish,") are generally much thicker than other scales; they are often oblong or rhomboidal, or lozenge-shaped in form, and seldom overlap one another, as in *Lepidosteus*, or Bony Pike of North America.

In nearly all fish a peculiar line, called "the lateral line," is to be seen; this line consists of a number of perforations in the scales, each scale having a pore with a minute tube leading into a longitudinal canal, which has the power of secreting a mucus to lubricate the surface of the whole body; a very desirable object, whereby the fish is enabled to dart through the watery medium in which it passes its life.

The digestive system in fishes consists of an œsophagus, a stomach, and an intestine. The mouth is usually furnished with teeth, which present greater diversity in their mode, as well as in their place of attachment, than is observable in any other class of animals. In some fishes almost every bone of the mouth is provided with teeth, and even the tongue is armed with these weapons; notably I may instance the teeth in the genus *Esox* (Pike), and in that of *Salmo*. Everyone knows what a formidable dental armature the Pike possesses; there are large and strong teeth of unequal size on the mandible, the maxillary is destitute of teeth, but the premaxillary, the vomer, the palatine, and the hyoid bones are thickly studded with cardiform* teeth, of which those of the palatines are the largest and disposed most irregularly. So again, what an effective apparatus for seizing and retaining hold of a

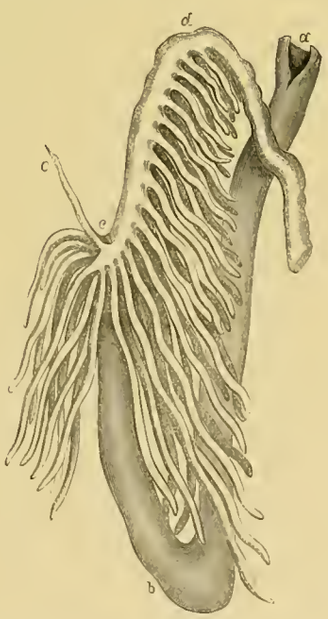
* *Cardiform* is from *carduus*, "a thistle;" or more directly from the brush set with wire-teeth for "carding" wool, cotton, etc.

slippery prey is possessed by the Common Trout! the vomer, palantines, intermaxillary, maxillary, the mandible, and the tongue are all furnished with sharp conical teeth. Some fish are entirely destitute of teeth in the mouth, others possess them in a very rudimentary form. In the family of the *Cyprinidæ*, as the Carp, Tench, Roach, etc., the mouth is utterly toothless, hence these fishes are popularly designated by anglers as "leather-mouthed" fishes; but he would make a very great mistake who would assert that these fish are altogether devoid of a dental apparatus. The teeth of the *Cyprinidæ* are situated in the throat, on the pharyngeal bones; though formed on one general type these bones and teeth present differences of form in different species, and this difference of form often possesses high value in the determination of closely allied species or of hybrids. I have dissected out these pharyngeal teeth from all the species of our *Cyprinidæ*, figures of some of which are given on page xvi. Let us notice the form and position of the dental apparatus in one of these fishes, and from thence deduce the functions thereof.



Dental apparatus of Tench.

The figure represents the dental apparatus of the Common Tench; *a* is the roof of the mouth, *b* is the œsophagus, *c* is a hardened and dilated projection from the basilar bone of the cranium; at *d*, *d* are seen the pharyngeal teeth. By means of strong muscles these



Portion of alimentary canal of Salmon.

a, cardia. *b*, pylorus. *d*, duodenum, or intestine, with numerous pyloric cæca at *c*. *e*, bile-duct.

teeth are worked upon the hardened body *c*, which forms a kind of anvil upon which the

bruising throat teeth work, and thus whatever food—which in the *Cyprinidæ* is frequently of a vegetable nature—passes into the œsophagus undergoes a triturating process whereby it is more readily rendered digestible.

The stomach of a fish is usually of a large size; it varies, however, both in size and shape; generally it forms a curved tube, like a siphon; the descending portion is called the *cardia*, the ascending part is the *pylorus*, which is generally provided with a valve. Sometimes the pyloric portion has its walls very much thickened, as in the *Salmo stomachicus*, or Gillaroo* Trout of the lakes of Ireland. Behind the pyloric opening of the stomach there are in many fish a number of blind tubes called the *appendices pyloricæ*, or "pyloric cæca;" they vary in number as well as in structure; there may be only two or three of these cæca, or there may be as many as two hundred; in form they may be simple short tubes, sometimes mere cylindrical capsules, as in Cole's Charr (*Salmo colii*), or they may consist of elaborate branches. It is supposed these appendages perform the function of the pancreas; in many fish they are altogether absent. Attention should always be given to these *pyloric cæca*, as they are sometimes of value in determining a species; the Galway Sea Trout (*Salmo gallivensis*), for instance, is at once recognised from the Common Sea or Salmon Trout (*S. trutta*) by the excessive shortness of these blind tubes.

Some fish are entirely carnivorous in their habits, others are to a great extent herbivorous; the solvent power in a voracious species of fish is most conspicuously exemplified; if, for instance, a Pike be captured soon after it has swallowed its prey, the head portion of the same, which is the part that generally first reaches the stomach, will be found more or less digested and dissolved, whilst that part which still remains in the gullet may remain entire. It is mentioned by Aristotle and other ancient writers as a curious fact, that the only fish known to ruminate is the Scarus.†

It appears, however, that amongst the *Cyprinidæ*, as the Carp, Tench, Roach, &c., and other herbivorous fishes, rumination is quite a normal process, and here the curious throat-teeth play a most important part. "The muscular action of a fish's stomach," says Professor Owen, "consists of vermicular contractions, creeping slowly in continuous succession from the cardia to the pylorus, and impressing a two-fold gyratory motion on the contents: so that, while some portions are proceeding to the pylorus, other portions are returning towards the cardia. More direct constrictive and dilative movements occur, with intervals of repose, at both the orifices, the vital contraction being antagonized by pressure from within. The pylorus has the power, very evidently, of controlling that pressure, and only portions of completely comminuted and digested food (chyme) are permitted to pass into the intestine. The cardiac orifice appears to have less control over the contents of the stomach; *coarser portions of the food from time to time return into the œsophagus, and are brought again within the sphere of the pharyngeal jaws, and subjected to their masticatory and comminuting operations.* The fishes which afford the best evidence of this ruminating action are the Cyprinoids (Carp, Tench, Bream,) caught after they have fed voraciously on the ground-bait, previously laid in their feeding haunts to insure the angler good sport. A Carp in this predicament, laid open, shows well

* The name of Gillaroo is a corruption of the Irish words *gilla*, *gille*, "a boy," "an attendant," and *ruadh*, "red;" "the red fellow," in allusion to the bright large red spots on this fish. Gill is the root of the word "gillie," the Salmon Fisher's *gillie* or attendant. Compare the Anglo-Saxon *gilda*, "a companion."

† The Scarus of the Ancients is doubtless the *Scarus cretensis* of Aldrovandi, a Mediterranean species noticed by Spratt and Forbes, still abundant on the Lycian shores; by means of its parrot-shaped mouth, it bites off and feeds on the stony corallines, nullipores, &c., its chief food. It is probable that the Scarus returns portions of the hard coralline contents of the stomach for trituration. Oppian has most clearly expressed the ruminating process in this fish in the following words—

και μουνος εδητυν
αψορρον προιησιν ανα στομα, δευτερον αυτις
δαινυμενος, μηλοισιν αναπτυσσων ισα φοσβην.
(Hal. i. 2.)

and long the peristaltic movements of the alimentary canal; and the successive regurgitations of the gastric contents produce actions of the pharyngeal jaws, as the half bruised grains come into contact with them, and excite the singular tumefaction and subsidence of the irritable palate, as portions of the regurgitated food are pressed upon it. The shortness and width of the œsophagus, the masticatory mechanism at its commencement, and its direct terminal continuation with the cardiac portion of the stomach, relate to the combination of an act analogous to rumination, with the ordinary process of digestion, in all fishes possessing these concatenated and peculiar structures."—(*Anat. of Verteb.*, i. p. 419.)



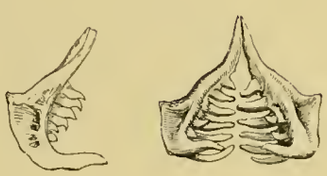
Azurine.



Tench.



Dace.



Rudd.



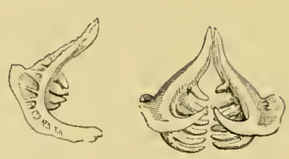
Roach.



Bream.



Barbel.



Pomeranian Bream.

In a letter with which Professor Owen, with his characteristic kindness, some few years ago favoured me, he says, "Continued observations under the rare and difficult circumstances according to which they can be made, have now convinced me, that matters for mastication by throat-chewers come *from behind*, as those by mouth-chewers *from before*. And indeed when one comes to consider how thoroughly and regularly the mouth of a fish is washed out by the branchial streams, there needs must be some special arrangement for the masticating machinery in lithophagus and phytophagous fishes. Consider what would be the consequence to the partially broken up coral and pulp, if retained at the back of the mouth, to be pounded piecemeal by the pharyngeals, the rush of two diverging streams through that faucial area going on the while like clockwork. No! the food, reduced if needful to a size swallowable, is bolted, and the branchial way speedily cleared. Then comes into play that anti-peristaltic rotation of the short gullet, and bit by bit the contents are shed in *a tergo* between the grinders till all is pulped."

A fish's intestine is usually short and wide, and more or less convoluted; the mucous membrane presents numerous modifications; it has often a spiral folding (as in the Sharks),

which winds in a corkscrew fashion from the pylorus to the anus; by these means of course the absorbing surface is considerably increased; it is generally thick and glandular, always vascular; it is reticulate in many fishes, as in the Muræna and the Sturgeon; in the Salmon the mucous membrane is more or less rugose.

The liver in fishes is generally of a large size and well developed, and frequently contains an enormous quantity of oil, this alone forming an important article of commerce; its texture is usually very soft; the lobes are often numerous; a gall-bladder, from which the bile is poured into the intestine through a single duct, which terminates near the pylorus (see fig. *c*), is, as a rule, present, though there are a few exceptions. Among fresh-water fishes, the gall-bladder is absent in the Lampreys.

In fishes the kidneys consist of two lengthened dark red-brown bodies, on each side of the median line of the body, beneath the vertebræ, extending through the whole or the greater part of the dorsal region of the abdomen. The kidneys of a fish are readily discernible; they form that long red band which lies adjacent to the backbone, easily seen after the extraction of the other viscera; it is that part of a fish which a careless cook fails to clean out thoroughly, which can only be done by means of several scrapings with the sharp point of a knife and copious ablutions of pure cold water.

The respiration of all fishes is purely aquatic; it is beautifully effected in all osseous fishes, with the exception of the *Lophobranchii*,—as the Pipe-fishes (*Syngnathus*), and the Sea-horses (*Hippocampus*),—by means of gills or *branchiæ*. These organs consist of a single or double series of flat cartilaginous bodies which support delicate fringes richly supplied with blood; above, the gills are united to the under side of the head; below, they are connected with the tongue or hyoid bone. The mechanism of the respiratory process is simple in nearly all osseous fishes. The water is taken in at the mouth, and bathes the branchial fissures; having lost its oxygen, the water is forcibly driven through the wide opening on each side of the neck called the gill-fissure, which fissure is closed in front by a series of flat bony scales called the gill-cover or "operculum." The normal number of these vascular branchial arches is four on each side of the hyoid bone in osseous fishes; in cartilaginous fishes the usual number is five; in the *Cyclostomata*, as in the Lampreys, it is seven; in these last-named fish the oxygenating water does not reach the branchial sacs through the mouth; it passes through the gill-sac openings by a tube leading into the pharynx, from whence it passes into the gill-sacs, these gill-sacs freely communicating with each other through the pharynx.

The smaller the external orifice of the gills, and the closer the gill-cover fits on these organs, the greater is the power in the fish to bear exposure to the outward air; so long as the branchial laminæ are kept moist, they can, to some extent, perform their function of appropriating to themselves the oxygen of the water retained within the branchial chamber; but when the external aperture of the gills is large, desiccation by the atmospheric air takes place, and the delicate branchial laminæ collapse, and death speedily ensues, for the blood can no longer effect a passage through them. Perhaps of all fresh-water fishes the Eel is best able to survive a lengthened period out of its watery element. In the Eels the gill-opening is a mere external fissure, a small vertical slit, and is removed very far back; so that the cavity, which lodges the branchiæ, is converted into a long chamber wherein can be retained a considerable quantity of water; so that in early summer mornings, when the dew is on the grass, Eels are able to make their overland-way to some distance from one piece of water to another.

The *Anabas*, or Climbing Perch of the tropics, has receptacles in which it can retain water, as in reservoirs, wherewith to moisten the folded branchial laminæ. Besides the branchiæ, most osseous fishes possess certain vascular bodies called "pseudobranchiæ." There are genera in which these organs have not been detected; they are situated on each side

of the head at the dorsal end of the first gill; each pseudobranch consists of a small exposed row of vascular filaments, or as "a vaso-ganglionic body, composed of parallel vascular lobes, and covered by the membrane of the branchial chamber, as in *Esox*, *Cyprinus*, *Gadus*. In both cases the vein or efferent vessel of the pseudobranchia becomes the ophthalmic artery."—(Owen.) This organ is small, but can be made out, where present, by the expenditure of a little patience in dissection.

The heart of a fish may almost be said to be in its mouth, so high up in the cavity of the body is it situated. Its situation is in the throat behind the last branchial arch; it is separated from the abdominal cavity by a strong septum. A fish's heart differs from the heart of another vertebrate animal by possessing only one ventricle and one auricle; the latter receives the venous blood from all parts of the body, while the former propels it through the branchial surfaces. From the ventricle there springs a large vessel called the branchial artery, the base of which in most fishes is developed into a strong muscular cavity, the *bulbus arteriosus*, which seems to serve as a kind of second ventricle. This branchial artery carries the venous blood to the gills, where it is oxygenated by the water. From the gills the blood is driven to a single dorsal artery (*aorta*), by whose branches it is conveyed to all parts of the body, returning by the veins to the auricle from which it originally started.

That curious piscine creature, the Lancelet, has no true heart; the circulation is effected by certain pulsating sinuses. In all fishes, except in the Lancelet, the blood is red and cold, that is, it has a temperature equal to that of the medium in which the fish dwells. In the Lepidosiren the heart possesses two auricles and one ventricle. The mention of this strange amphibian-like fish leads me to mention an organ that exists in many fishes, called the "swim-bladder," or "air-bladder," with which every fisherman is familiar. This air-bladder, which is very variable in form according to the species of fish, is a sac filled with gas; it extends along the back of the abdomen, between the kidneys and the intestinal canal. Sometimes, as in the Perch, it is a simple elongated cylinder closed at both ends; sometimes, as in the Carp, Tench, Roach, and other *Cyprinidæ*, this organ is divided crosswise into two portions by a deep constriction, with a minute orifice leading from the one portion to the other. Now this air-bladder is sometimes, and often, simply a closed sac; but in some fishes it opens into the œsophagus by a narrow channel or duct, called the *ductus pneumaticus*. How does the gas or air gain admittance into the bladder? In the case of those fish whose air-bladders possess no *ductus pneumaticus* it seems that the gas must be secreted by the inner membrane of the bladder from the blood; but in fishes which are provided with a *ductus pneumaticus*, so as to lead to a communication with the gullet, the air generated within may be in a great measure derived from the atmosphere. The contained gas of the air-bladder of fishes consists of a mixture of nitrogen and oxygen with traces of carbonic acid; in fresh-water fishes the largest percentage of nitrogen occurs; in salt-water fishes oxygen is said to occur in the largest proportion. Some, I believe, have maintained that the gas of the swim-bladder of Carps consists of pure nitrogen. Humboldt, who experimented on the Electric Eel, (*Gymnotus electricus*), found the gas of its air-bladder to consist of ninety-six per cent. of nitrogen and four of oxygen. Biot, on the other hand, experimenting on some deep-sea Mediterranean fishes, discovered eighty-seven per cent. of oxygen, the rest nitrogen with a trace of carbonic acid.*

* The late Dr. Davy was rather doubtful as to the accuracy of these experiments. He remarks, "That the same organ should secrete two gases so very different in their nature appears anomalous and deserving of further enquiry. Indeed does not the entire subject need more minute enquiry? At present the facts relating to it are few, and seem far from adequate to allow of very satisfactory conclusions being drawn as to the use of the bladder and its secretion in the animal economy, except of a mechanical kind as affecting the specific gravity of the fish. Were the gas uniformly of one kind, were it constantly azote, it might be easy to assign it a plausible end; the function of the air-bladder might be inferred to be auxiliary to that of the kidneys. The secretion of oxygen is the anomalous fact, so contrary is it to the ordinary changes in living animals, in which the general tendency is to the consumption of

The swim-bladder does not exist in all fishes; in the Lampreys it is entirely absent; it does not exist in the Sharks, Dog-fish, Rays, and the Chimera. There is a swim-bladder and an air-duct in the Eel, Herring, Salmon, Pike, Carp, Silurus, with their allies; in the order *Anacanthini*, as in the Ophidium, Cod, and Plaice, the air-bladder when present has no pneumatic duct; in the *Acanthopterygii* or spiny-finned Fishes, as in the Perch and Miller's Thumb amongst fresh-water species, the air-bladder, where it exists, is without a pneumatic duct, the same is the case with the orders *Plectognathi*, File-fish, Trunk-fish, Globe-fish, and *Lophobranchii*, Pipe-fishes and Sea-horses. In the sub-class *Dipnoi*, or "Double-breathers," as in the *Protopterus annectens* of Tropical Africa, and the *Lepidosiren paradoxa* of Brazil, we meet with a most interesting form of air-bladder: it is double, cellular, and lung-like, and is provided with an air-duct, glottis, and pulmonary vein.

What then are the functions of the swim-bladder and air-duct, when present? What does their presence appear to indicate? Will it serve to throw any gleam of light on that most interesting subject, the origin of species? There can be no doubt that "under all its diversities of structure and function, the homology of the swim-bladder with the lungs is clearly traceable." True, there is nothing at all in the simple cylindrical closed air-bladder of a Perch, with its shining silvery fibrous tunic, to remind one of the cellular structure of the lung of an amphibian; but it must be remembered that there are numerous gradations, leading by various transitions, from a single cavity up to a highly complex cellular organ, which both in structure and function is indisputably a lung. The fishes which most closely resemble the amphibians are the *Protopterus annectens*, or Mud-fish of Tropical Africa, and the *Lepidosiren paradoxa*, of the river Amazon and its tributaries. In *Protopterus*, we find these traditions complete, for here we see a double lung-like air-bladder, with air-duct, glottis and pulmonary vein, and this respiratory apparatus, be it remembered, is at certain periods functionally identical with the lungs of air-breathing vertebrates; for *Protopterus*, after the rains have ceased to flood the river Gambia, finds itself left behind in the mud of the retreating waters; the scorching rays of a tropical sun compel the fish to burrow in the mud, in which it forms a kind of cocoon of hard-baked clay. How is the fish to live in this changed locality? As an inhabitant of the water, the respiration was effected by means of gills alone, as in ordinary fishes; but how is the circulation to be maintained now that it is a terrestrial animal; Professor Owen tells us in clear and distinct terms. "Whatever amount of respiration was requisite to maintain life during the dry months is effected in the pulmonary air-bladders; its short and wide duct or trachea, the œsophageal origin of which is kept open by a laryngeal cartilage, introduces the air directly into the bladders; the blood transmitted through the branchial arches to the pulmonary arteries, is distributed by their ramifications over the cellular surface of the air-bladders, and is returned arterialised by the pulmonary veins. A mixed venous and arterial blood is thence distributed to the system and again to the air-bladders." —(*Anat. of Vert.*, i. p. 498.) When the *Protopterus* resumes its piscine nature on the return of the water, the branchial circulation again comes into play. In this fish, therefore, we have an instance of an animal which is a fish at certain periods of its existence, and an amphibian at others; and I believe with Darwin that natural selection has operated "in converting a swim-bladder into a true lung, used exclusively for respiration."

It surely is quite conceivable that under changed conditions, acting for a lengthened period, the Salamandroid Protopterus—which some naturalists of note maintain to be more allied to amphibia than to fish—might gradually convert its ichthycic characters into amphibian ones, just as I believe it has converted, not only the swim-bladder and pneumatic duct into an air-breathing lung, trachea and glottis, but also two pairs of the gills of the branchial

oxygen. *A priori*, one might almost as much expect oxygen to be exhaled from the lungs, in respiration, as to be separated from the blood by secretion in the air-bladder; and had we not the authority of so accurate an observer as M. Biot, we might be led to suspect that the statement of its being so was founded on error."—(*Physiol. Res.* p. 271.)

arches into vascular channels, in order that it should be able to maintain a slow circulation as a terrestrial animal, when encased in its cocoon of mud. I see nothing improbable in the supposition that in *Protopterus* we have a living witness of a fish in a transition stage towards becoming, in course of time, under favourable conditions, a true amphibian; and I do believe that amphibia are altered forms of fish, to which in some cases, they bear a considerable resemblance; and I think it probable that one of the steps in the transition—and a most interesting and important step it is—is made by the gradual conversion of the swim-bladder and pneumatic duct, into a lung, trachea, and glottis.

Generally speaking, the function of a fish's swim-bladder is no doubt merely a mechanical one; but this organ cannot be of much importance, nor does it exhibit "such a plain and direct instance of mechanical contrivance" as was maintained by Paley, Roget, Cuvier, and others. For how is it that in different genera of fishes, of precisely similar habits, some have an air-bladder, others have not? One can at once understand why such an organ should be absent in the *Pleuronectidæ* (Soles, Turbots, Flounders, etc.), whose habits confine them to the bottom of the water, and which do not, therefore, require the mechanical upward lift afforded by an air-bladder; but when we find that one surface-swimming Mackerel (*Scomber colias*) has a swim-bladder, and another (*S. vulgaris*), of precisely similar habits, is devoid of one, it is obvious, notwithstanding the general function of the organ when present, that it is by no means an essential adjunct to swimming. Many of the *Siluridæ* possess a large and sometimes complex swim-bladder, but genera occur in which there is no swim-bladder at all. The air-bladder in the *Siluridæ*, and in some of the *Cyprinidæ*, communicates with the organ of hearing by means of the ear-bones, or auditory ossicles, and doubtless serves to intensify the sound. Fish that keep to the bottom, are, as a rule, devoid of this organ, but in the mud-loving Eel we meet with swim-bladder and pneumatic duct.

With respect to the reproductive system, fishes are generally *oviparous*. In osseous fishes, as a rule, the ova are deposited and impregnated by the milt of the male externally. This is the case with all our fresh-water species. Rare instances are met with, as in the marine viviparous Blenny, in which the females produce offspring already somewhat advanced in growth. In such cases impregnation must occur internally, though no structural peculiarity is to be detected in the male or female organs. In the cartilaginous Sharks and Dogfish the generative apparatus is different, and approximates to a certain extent that type of structure observable in reptiles and birds. The ova of the female fish is familiarly known as the "roe;" the milt of the male is spoken of as the "soft roe."

In the construction of their nervous and cerebral system fishes stand the lowest in the vertebrate scale. I cannot do better than quote the remarks of Cuvier on the general attributes of fishes, and their relative position in the animal scale.

"Breathing by the medium of water, that is to say, only profiting by the small quantity of oxygen contained in the air mixed with the water, their blood remains cold; their vitality, the energy of their senses and movements, are less than in mammalia and birds. Thus their brain, although similar in composition, is proportionally much smaller, and their external organs of sense not calculated to impress upon it powerful sensations. Fishes are in fact, of all the vertebrata, those which give the least apparent evidence of sensibility. Having no elastic air at their disposal, they are dumb, or nearly so, and to all the sentiments which voice awakens or entertains they are strangers. Their eyes are, as it were, motionless, their face bony and fixed, their limbs incapable of flexion and moving as one piece, leaving no play to their physiognomy, no expression to their feelings. Their ear, enclosed entirely in the cranium, without external concha, or internal cochlea, composed only of some sacs and membranous canals, can hardly suffice to distinguish the most striking sounds, and, moreover, they have little use for the sense of hearing, condemned to live in the empire of silence, where everything around is mute.

Even their sight in the depths which they frequent could have little exercise, if most of them had not, in the size of their eyes, a means of compensation for the feebleness of the light; but even in these the eye hardly changes its direction, still less by altering its dimensions can it accommodate itself to the distances of objects. The iris never dilates or contracts, and the pupil remains the same in all intensities of illumination. No tear ever waters the eye—no eyelid wipes or protects it—it is in the fish but a feeble representative of this organ, so beautiful, so lively, and so animated in the higher classes of animals.

Being only able to support itself by pursuing a prey, which itself swims more or less rapidly, having no means of seizing it but by swallowing, a delicate perception of savours would have been useless if nature had bestowed it; but their tongue, almost motionless, often entirely bony or coated with dental plates, and only furnished with slender nerves, and these few in number, shows us that this organ also is as obtuse as its little use would lead us to imagine. Their smell even cannot be exercised so continually as in animals which respire air and have their nostrils constantly traversed by odorous vapours.

Lastly, their touch, almost annihilated at the surface of their body by the scales which clothe them, and in their limbs by the want of flexibility in their rays, and the nature of the membranes investing them, is confined to the ends of their lips, and even these in some are osseous and insensible.

Thus, the external senses of fishes give them few lively and distinct impressions. Surrounding nature cannot affect them, but in a confused manner; their pleasures are little varied, and they have no painful impressions from without but such as are produced by wounds.

Their continual need, which, except in the breeding season, alone occupies and guides them, is to assuage the internal feeling of hunger, to devour almost all that they can. To pursue a prey or to escape from a pursuer makes the occupation of their life; it is this which determines their choice of the different situations which they inhabit; it is the principal cause of the variety of their forms, and of the special instincts or artifices which nature has granted to some of the species.

Vicissitudes of temperature affect them little, not only because these are less in the element which they inhabit than in our atmosphere, but because their bodies taking the surrounding temperature, the contrast of external cold and internal heat scarcely exists in their case.* Thus the seasons are not so exclusively the regulators of their migration and propagation as amongst quadrupeds, or more especially birds. Many fishes spawn in winter; it is towards autumn that Herrings come out of the north to shed upon our coast their spawn and milt. It is in the north that the most astonishing fecundity is witnessed, if not in variety of species, at least in individuals; and in no other seas do we find anything approaching to the countless myriads of Herrings and Cod which attract whole fleets to the northern fisheries.

The loves of fishes are cold as themselves; they only indicate individual need. Scarcely is it permitted to a few species that the two sexes should pair, and enjoy pleasure together; in the rest the males pursue the eggs rather than seek the females; they are reduced to impregnate eggs, the mother of which is unknown, and whose produce they will never see. The pleasures of maternity are equally unknown to most species; a small number only carry their eggs with them for a short time; with few exceptions fishes have no nest to build and no young to nourish; in a word, even to the last details, their economy contrasts diametrically with that of birds."†

* Sudden change of temperature, however, does affect some kinds of fish in a most marked manner. When placed at once into very cold water, at a temperature considerably lower than the water from which they have been taken, fish will often turn on their backs, become apparently paralyzed and die. The reader will find some interesting experiments on "The Degree of Temperature fatal to Fishes,"—the temperature in these cases being that of warm or hot water—in Dr. J. Davy's *Physiological Researches*, p. 297-305. The experiments were made at Oxford some years ago in conjunction with Mr. Robertson, Demonstrator at the Museum, Oxford, and my valued friend, Professor Rolleston.

† *Cyclop. Anat. & Phys.*, iii. p. 955-6.

The great class of Fishes (PISCES,) is by some naturalists divided into the following six sub-classes, (1) *Teleostei*, (2) *Dipnoi*, (3) *Ganoidei*, (4) *Chondropterygii*, (5) *Cyclostomata*, (6) *Leptocardii*. I follow Dr. Günther in the following classification:—

The first sub-class of TELEOSTEI contains all those fishes which have a complete bony skeleton; this sub-class comprehends more species than all the other sub-classes put together, and nearly all our British fresh-water species belong to this great sub-class. It contains the following orders, which are again themselves divided into different families, the families into genera, and the genera into species.

Order I.—ACANTHOPTERYGII, from ακανθος, "a spine," and πτερυξ, "a wing," or "fin," contains those fishes whose fin rays form spines, as in the Common Perch. The air-bladder, when present, has no pneumatic duct.

Order II.—ACANTHOPTERYGII-PHARYNGOGNATHI, contains those species in which the inferior pharyngeal bones coalesce, as in the marine *Labridæ* or Wrasses; air-bladder without pneumatic duct. There is no British fresh-water species belonging to this order.

Order III.—ANACANTHINI, in which, excepting in one genus, the vertical and ventral fins are without spinous rays; from α, "not," and ακανθος, "a spine." Air-bladder, when present, without pneumatic duct. This order contains two sub-orders, (*a*) GADOIDEI (Codfish families), and (*b*) PLEURONECTOIDEI (Flat-fish, Soles, Turbots, etc.) We have a single fresh-water representative of sub-order (*a*) in the Eel-pout, or Burbot, *(Lota vulgaris)*: and of sub-order (*b*) in the Flounder *(Pleuronectes flesus)*, which is known to ascend our rivers to a considerable distance; some years ago Flounders were common in the Severn as high up as Shrewsbury.

Order IV.—PHYSOSTOMI. This is an extensive order, and comprises several families, as the *Cyprinidæ*, *Clupeidæ*, *Esocidæ*, *Salmonidæ*, and *Muræenidæ*, all of which have British fresh-water representatives. The fin rays are articulated; the first of the dorsal and pectoral being sometimes more or less bony; the spineless ventral fins, when present, are not situated near the pectorals, but on the abdomen. The word *Physostomi* is from the Greek φυσα, "a bladder," and στομα, "a mouth," in allusion to the air-bladder, when present, being connected with the mouth or gullet by means of the pneumatic duct, which is the invariable accompaniment of the air-bladder in this order. Carp, Shad, Pike, Salmon, and Eel are fresh-water representatives of this order.

Order V.—LOPHOBRANCHII, from λοφος, "a tuft," and βραγχια, "the gills." In this order the gills are formed of small rounded lobes, and are not laminated. The air-bladder has no pneumatic duct. Marine examples are Sea-horses (*Hippocampus*), and Pipe-fishes (*Syngnathus*). There is no fresh-water representative.

Order VI.—PLECTOGNATHI, from πλεκτος, "twisted," or "fastened together," and γναθος, "the jaw," because generally the maxillary and præmaxillary bones of the mouth are immovably connected on each side of the mouth, as in the genera *Ostracion* (Trunkfish), *Balistes* (Filefish), and *Orthagoriscus* (Sunfish). Of this order there is no British fresh-water representative; indeed Günther tells us that nearly all are marine fishes. The air-bladder has no pneumatic duct.

Sub-class II.—DIPNOI is one of the most interesting of all the sub-classes; the word means "double breathers." This has already been explained on pages xix-xx, to which the reader is referred. Two genera and two species only are known, the *Protopterus annectens* of tropical Africa, which has three external branchial appendages, and the *Lepidosiren paradoxa* of Brazil, which is destitute of external appendages.

Sub-class III.—GANOIDEI has the skeleton more or less ossified; the scales often are hard and polished (γανος, "brightness"); ventral fins, when present, are abdominal; the intestine has a spiral valve. It is divided into two orders:

I.—Holostei. Body covered with scales; skeleton bony.

A. Scales cycloid. 1. *Amiidæ* (Bowfin or Mudfish of the fresh waters of North America).

B. Scales ganoid.

(*a*) Fins without fulcra. 2. *Polypteridæ*. Fresh waters of Central and Western Africa.

(*b*) Fins with fulcra. 3. *Lepidosteidæ*, as the Bony Pike (*L. osseus*) of North America.

II.—Chondrostei. Skin naked, or with osseous bucklers; skeleton partly cartilaginous.

A. Mouth small, transverse, inferior. *Acipenseridæ* (Sturgeons).

B. Mouth lateral, very wide. *Polyodontidæ* (Spoonbill Sturgeon of the Mississippi and tributaries).

Fresh-water representative of *A* is met with in the Sturgeon.

Sub-class IV.—CHONDROPTERYGII. In this sub-class the fish have a cartilaginous skeleton, and the skull is without sutures; the tail has a produced upper lobe; the gills are attached to the skin by the outer margin, with several intervening gill-openings; rarely with one gill-opening only; no gill-cover; no air-bladder; intestine with a spiral valve; ovaries with few and large ova impregnated internally, and in some cases developed internally. Males with prehensile organs attached to the ventral fins. Contains two orders.

I.—Holocephala. One external gill-opening only, as in the *Chimæra monstrosa* (Arctic Chimæra).

II.—Plagiostomata. From five to seven gill-openings.

Sub-order 1.—*Selachoidei*. Gill-openings lateral (Sharks and Dog-fish).

Sub-order 2.—*Batoidei*. Gill-openings ventral (Rays).

Of this sub-class there is no British fresh-water representative.

Sub-class V.—CYCLOSTOMATA, contains fishes whose skeletons are cartilaginous, and notochordal, which have no ribs, no real jaws; whose skull is not separate from the vertebral column, and which are limbless; the gills have no branchial arches, but are in the form of pouches or sacs, generally seven in number on each side of the neck; there is only one nasal aperture; and the heart has no bulbus arteriosus. The mouth is suctorial in the mature form, or crescent-shaped in the larval form. The alimentary canal is simple, straight, without cæcal appendages, pancreas, or spleen.

There are two families, viz:

1.—*Petromyzontidæ*, in which the nasal duct terminates blind, not penetrating the palate; as in the Lampreys.

2.—*Myxinidæ*, in which the nasal duct penetrates the palate, (Glutinous Hag).

In the sub-class VI.—LEPTOCARDII, the only representative, I believe, is the Lancelet (*Branchiostoma lanceolatum*,) occasionally found on the English southern coasts. This fish occupies the lowest scale amongst vertebrate animals; its skeleton is membrano-cartilaginous and notochordal; it has no ribs, no brain, pulsating sinuses in place of a heart; the blood is colourless; the respiratory cavity is confluent with the abdominal cavity, the branchial clefts are numerous, and the water is expelled by an opening in front of the vent. There are no jaws.

The British ichthyological fauna numbers about two hundred and fifty species, of which about fifty-five are either permanently or periodically inhabitants of fresh water. With the exception of the Sturgeon and the Lampreys, all the fresh-water fishes of the British Isles belong to the great sub-class Teleostei, and to the orders, I. *Acanthopterygii*, which contains six species; III. *Anacanthini*, two species; and IV. *Physostomi*, all the remaining species, represented by the families *Cyprinidæ*, *Clupeidæ*, *Esocidæ*, *Salmonidæ*, and *Muræenidæ*.

Fish, like other creatures, are subject to diseases. Various parasites, either in the form of *Entozoa* or *Epizoa*, find a lodgment within or upon their bodies. The internal parasitic hosts are very numerous; they occur generally in the stomach, pyloric appendages, and intestine, in the form of various kinds of tapeworm (*tænia*), or small filamentous annelids (*ascaris*). Sometimes intermuscular parasites are found, but this is less common, I believe, in fish belonging to this country than in some foreign species. The *Epizoa* are found on the surface of the bodies of fishes; various forms of *Crustacea*, such as *Lernæa*, *Lepeophtharies*, *Argulus foliaceus*, attack them; the curious little *Gyrodactylus elegans* I have found inside the gills of the Three-spined Stickleback; the young fry of the fresh-water swan mussel (*Anodonta cygnea*), I have detected on the fins of the Perch, Stickleback, and a few other fishes; Pike are sometimes, when in a weak and unhealthy state, covered with that curious little discophorous annelid, *Piscicola*. As a rule, however, I do not think that parasitic guests affect fish very seriously. When *epizoa*, or external parasites, abound to a great extent, the fish is, no doubt, injured by them, and a weakly condition of the fish may be to some extent the cause of their attacks. But although the presence of animal parasites, whether external on the skin or internal within the viscera, may be unproductive of much serious mischief, it is quite different with certain subtle forms of vegetable growth, which often occasion fearful destruction, like some epidemic amongst the higher animals.

One essential condition for health in a fish is undoubtedly pure water; this is specially the case in the *Salmonidæ*. Some fish, however, will certainly exist, and apparently thrive, in water which can by no means be called pure. I have taken the Three-spined Stickleback from very foul ditches indeed. Carp and Tench will do fairly well in muddy pools, but they will do better still, and prove more fitted for the table, if kept in ponds supplied by bubbling springs, and containing aquatic plants of various kinds, with a muddy bottom in which they can hybernate in the cold winter. As a rule salt-water fishes are much less liable to suffer from parasitic attacks than fresh-water species. Mr. Jackson, the able Curator of the Southport Aquarium, tells me that fresh-water fish do not thrive in confinement; that they are extremely liable to be attacked, to an injurious extent, by parasites, but that this is not the case with fish in the salt-water tanks. One of the most dreaded and fatal of all the diseases to which piscine nature is subject, occurs in the form of white flocculent patches on the tail, head, or other parts of a fish's body. Everyone, with the slightest experience, must have observed what I am alluding to, if he has merely kept Goldfish in glass globes. This white filamentous growth is either a fungus, or some plant related to a fungus; it is known by the name of *Saprolegnia ferax*, and sometimes does incalculable mischief in some of our Salmon rivers. In ponds or tanks where young Trout are artificially cultivated, thousands often die from the attacks of *Saprolegnia ferax;* and I feel certain, from what I have noticed myself, that this fatality is primarily caused by overcrowding in a water which has too high a temperature. It is generally easier to prevent the appearance of a disease than to stop its ravages when it has once begun. Now it is an ascertained fact that fungi of all kinds require for their development a certain warmth of temperature, and that cold will prevent the spores of a fungus from germinating. This holds good with regard to the larger kinds of fungi, as well as to those almost infinitesimal atoms, such as *Bacteria*, *Bacillaria*, &c., which are doubtless at the root of many zymotic diseases affecting men and other highly organized animals.

On the subject of the fungoid growth known as *Saprolegnia ferax* affecting Salmon, I cannot do better than quote the remarks of my friend, Mr. W. G. Smith, a very competent authority on all questions relating to mycology. He writes:—

"For several weeks past the newspapers have contained accounts of the diseased condition of various fish in several of our northern rivers—principally the Esk and Eden. The disease of the fish is caused by the attack of a fungus. No doubt every one with a slight acquaintance with fungi suspected from the first that the disease was similar to the familiar disease of Goldfish in aquaria, and no other than the common *Saprolegnia ferax*. From material kindly forwarded to the writer for examination from Carlisle by Mr. George Brookter, of Huddersfield, there seems to be no reason to doubt the identity of the parasite with the common pest of Carp—*Saprolegnia ferax*.

According to the newspaper reports we find that the owners of the Salmon fisheries on the Tweed, and the Commissioners to whom the protection of the fisheries is entrusted, have for years been disturbed, distressed, and annoyed by a great mortality which comes over the fish towards the end of the spawning season. Any time during February, and anywhere between Stobo and Berwick, dead Salmon may be seen by the half dozen in every pool. The epidemic is thus described:—Large numbers of Salmon—not only kelts, but clean fish lately arrived from the sea—appear to be affected with an epidemic which destroys hundreds of them. The head and tail first, and gradually the whole body is attacked by a disease which appears to eat away the flesh, turning it white, and giving the fish the appearance of being affected with leprosy. Such fish are entirely unfit for food. Correspondents describe them as leaping out of the water, as if in pain and in frantic efforts to escape; some return to the sea, but many perish in their attempts to reach the salt water. The Salmon caught in the estuary are not diseased in this way, and, as the epidemic is said to be spreading to the Trout, it would appear that some peculiar condition in the fresh water is the cause of the remarkable phenomena. Some of these characteristics of the disease are not confirmed by a more correct observation and less hasty deduction, but what is said enables one to recognise the malady which for several years past has slain its thousands of Salmon on the Tweed. In both rivers the afflicted animals suffer violent pain, and rush blindly about as if brain disease existed through generally inflammatory action, and in both rivers the dead bodies present a similar appearance.

The various theories which have been published in the daily papers as to the cause of the disease and the 'cause of the fungus' have no foundation in fact. The most common theory seems to be that the Salmon die from disease induced from inflammatory action arising from retention of the milt. The theory of the fishery owners and the Commissioners does not afford even the small consolation that the fish die a natural death, for they hold, and are ready to affirm on oath, that the vile pollutions of the woollen mills and towns on Tweedside cause all the evil. The controversy has continued for years, but now some facts have turned up in Cumberland and Westmoreland which must carry a verdict of acquittal for the millowners. A short time ago large numbers of dead Salmon were found in the Kent, a river which is as pure as Thirlemere itself. No pollution, wilful or accidental, could be traced, and the authorities had to confess their ignorance of the cause of death, coming to the illogical conclusion that it arose from exhaustion after spawning, oblivious apparently that this has happened every year since Kent was a river, and the deaths have been heard of only now. From a statement in the *Times* it appears that things piscatorial are much worse in the Eden, which flows through a beautiful country guiltless of the offences of factories.

The *Carlisle Journal* says, 'Large numbers of kelts—that is, fish that have spawned—are found in pools and floating down the stream dead and dying. The appearance of the disease is that of a white fungus. This affects the head of the fish, then it attacks the tail, and subsequently the fins. In some instances the fungus grows so plentifully that the fish appears to be swimming about with a white nightcap over its head. Salmon smolts and Trout are also affected by the disease. An unusual number of kelts have remained in the Eden this year, and many of them have died; so many, in fact, that the water bailiffs have been employed in picking them out of the water and burying them.'

This disease is by no means confined to Salmon and young Salmon (smolts), but Trout, Eels, Lampreys, Flounders, Minnows, and other fish, are equally affected. A watcher on the Esk informed Mr. Brookter that the disease nearly always starts at the nose, and gradually spreads over the head; the fish, he affirmed, would come to a still part of the river with only a small patch on the nose, and in two or three days the patch would have extended over the head, and at the same time have appeared on the base of the fins and tail. The disease is said to be generally confined to the parts mentioned, unless the fish has had a bruise or scar anywhere so as to remove the scales. From an examination of actual specimens, however, it seems proved that the disease by no means always commences at the head. With a very low power of the microscope the fungus will be seen to consist of a dense mass of matted threads without joints, and a thick forest of minute transparent clubs.

If asked for a reason for the uncommon abundance of the fungus this year, I should be inclined to refer it to the extraordinary mildness of the late winter. Severe weather, or a sudden change of temperature, will generally collapse fungi of the nature of *Saprolegnia ferax*, as will several dilute chemical infusions, and that without damaging the fish; but an experiment, though successful in an aquarium, might possibly fail in a large river.

The fungus has been described as infesting the dead, as well as the living, fish; but with me the fungus has invariably vanished with the death of the fish. Dead fish are certainly covered with a white cottony coating, but on an examination of this flocculent mass, under the microscope, it is found to consist wholly of white granular matter, consisting of bacteria, monads, etc., and no fungus threads or fruit belonging to *Saprolegnia ferax* can be seen.

The disease has been so virulent on the Esk, during the present spring, that the watchers have in some instances buried as many as three hundred and fifty fish in three days between Langholm and Longtown."—*Gardeners' Chronicle*, *pp.* 560-561, 1878.

Pisciculturists, interested in the artificial rearing of the *Salmonidæ*, should bear in mind the following, as I think, important essentials for success:—*

1. The water in which the ova or young fry are placed should be cold, at a temperature of 37° to 47°.

2. The fry should be always supplied with gravel, stones, or projecting pieces of rock-work, under which they can shelter.

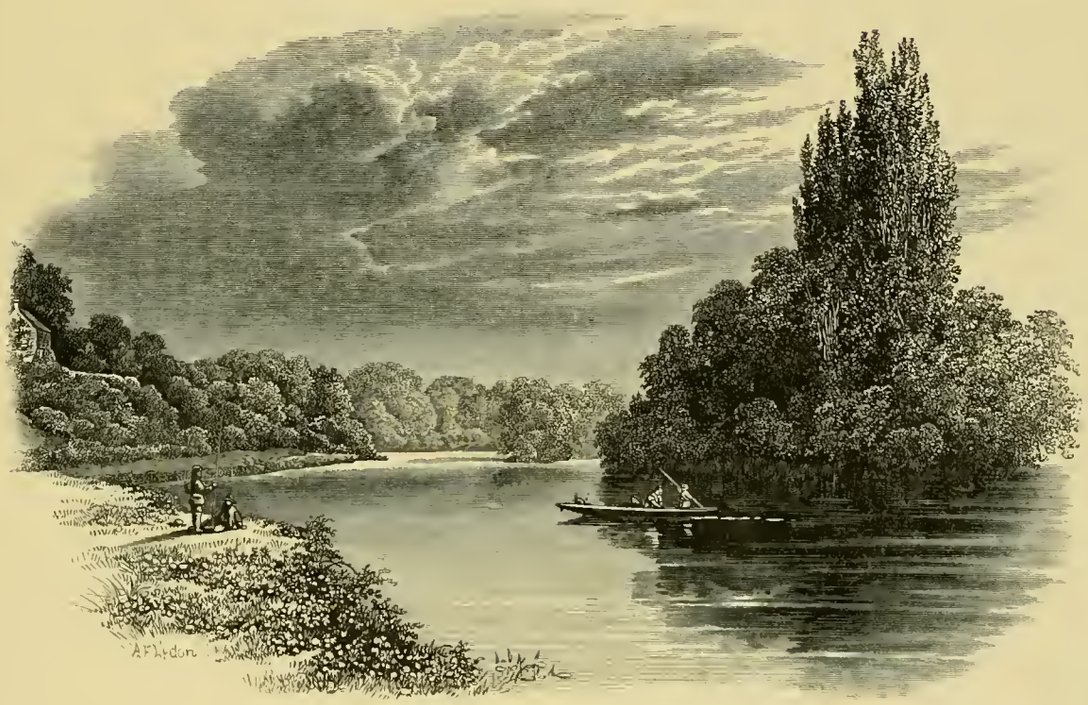
3. The pond, tank, or reservoir should always be covered over with boards or other material, to exclude the hot rays of the sun.

4. Overcrowding must be avoided, or the fish will be attacked with *Saprolegnia ferax*, an epidemic which when once begun, it will be found almost, if not quite, impossible to stop.

5. A stream of pure cold water should incessantly be running, day and night, *briskly* through the preserve.

* The best food for young Trout and Salmon is a hard-boiled egg, passed by pressure and friction through the gratings of a fine strainer.

BRITISH FRESH-WATER FISHES.



ON THE THAMES, NEAR ROEBUCK INN.

Order I.
ACANTHOPTERYGII.

Family
PERCIDÆ.

PERCH.

(*Perca fluviatilis.*)

PERKE,	ARISTOTLE, H. A., ii. 9 § 4; 12 § 13, vi. 13 § 2.
Perca,	PLINY, xxxii. 9; AUSON., Id. x. 115.
Perca fluviatilis,	RONDEL., ii. 196; WILLUGHBY, iv. c. 14, p. 291; LIN., i. p. 481; YARRELL, Brit. Fish., i. p. 1; GÜNTHER'S Cat. i. p. 58; COUCH'S Fish. Brit. Isles, i. 185.

Characters of the Genus PERCA.—"Seven branchiostegals. All the teeth villiform, without canines; teeth on the palatine bones, tongue smooth. Two dorsals; the first with thirteen or fourteen spines; anal fin with two spines; operculum spiniferous; præoperculum and præorbital serrated. Scales small; head naked above."—GÜNTHER.

OF the family *Percidæ* there are only two British fresh-water species, the Common Perch (*Perca fluviatilis*) of our ponds, lakes, and rivers, and the Ruffe or Pope. The Perch was known to the ancient Greeks and Romans. Aristotle speaks of it under the name of

Πέρκη; he says that the Perch produces its eggs in a continuous series like frogs, and that the fishermen unwind the broad entangled mass from among the reeds in ponds; this description at once enables us to identify the fish with certainty; but Aristotle under the same name seems to have also included some marine species, as the Bass or Sea Perch. Pliny recommends the burnt ashes of salted perch-heads as a remedy to dispel pustules (xxxii. 9). Ausonius was certainly acquainted with the fresh-water Perch, and appreciated its excellent qualities as food when he says—

"Nec te delicias mensarum, perca, silebo,
Amnigenas inter pisces dignande marinis,
Solus puniceis facilis contendere mullis." (x. 115.)

"Nor will I pass thee over in silence, O perch, the delicacy of the tables, worthy among river-fish to be compared with sea-fish; thou alone art able to contend with the red mullets."

The Perch occurs in many of the fresh waters of Europe, and in Asiatic Russia. In England it is extremely common in rivers, lakes, ponds, and canals; in Wales it is said to be rather a local fish and chiefly confined to stagnant waters; in Scotland it is not found north of the Forth, except where it has been introduced; in all the almost countless waters of the northern counties of Scotland, Yarrell states that the Perch is said to be wanting; farther north, as in Orkney and Shetland, the Perch does not occur, while still farther north, as in various parts of Scandinavia, it is again found. In the rivers and lakes of Ireland the Perch has been long known to occur. According to Couch the Perch is not a native of Cornwall, though it has been introduced within the present century, and where found it thrives well.

Perch deposit their spawn during the month of April and at the beginning of May, and a most curious and beautiful object is the spawn which they produce; it consists of a broad band of network of pearl-like eggs, a foot or considerably more in length; it is unfortunately very readily discerned, as it adheres to bushes or weeds in the water; consequently vast quantities of the spawn are devoured by ducks, swans, and other enemies. The number of eggs contained in one of these pearly festoons has been estimated at the enormous quantity of 155,000 and 280,000; the band is a hollow tube, and can be placed on the wrist as a bracelet.

The Perch attains to about the size of two inches and a quarter in a year, and a two year old will measure about five inches. I believe that when two years old they are able to mature spawn. The growth of Perch, as of other fish, depends in a great measure upon the localities where they are found. In large pools, and in rivers where the fish are not too numerous, and where food is abundant, Perch grow to a large size, but in small ponds they never attain to any size, though they will breed abundantly. Being voracious feeders, food is a very important consideration, and where ponds abound with these fish a sufficiency of food is not easily obtained. Some pisciculturists recommend that the sexes should be separated, the females being placed in one piece of water and the males in another; where this is done the Perch are said to grow well and rapidly. There is no fish, perhaps, that gives better sport to the youthful angler than the Perch; bold, and always ready for a worm, minnow, or other food, they fall easy victims to the baited hook. The following instance of the voracity of the Perch is given by Mr. Cholmondeley Pennell in the *Angler Naturalist*, (p. 61):—

"A very singular, if not unparalleled instance of the voracity of the Perch occurred to me when fishing in Windermere. In removing the hook from the jaws of a fish, one eye was accidentally displaced, and remained adhering to it. Knowing the reparative capabilities of piscine organization, I returned the maimed Perch, which was too small for the basket, to the lake, and being somewhat scant of minnows, threw the line in again with the eye

attached as a bait—there being no other of any description on the hook. The float disappeared almost instantly; and on landing the new comer, it turned out to be the fish I had the moment before thrown in, and which had thus been actually caught by his own eye."

Perch are for the most part gregarious, and swim in shoals, so that when the angler has come across a shoal he generally manages to catch several. I have, on some occasions, been very successful in taking large numbers of good-sized Perch by means of eel-lines, the hooks being baited with a lob-worm, and the line thrown into the water with the bait on the ground, the other end of the line being fastened to the bank by a peg. Minnows are very attractive bait to the Perch, and fishing with one of these natural baits is a successful method of taking good fish; but so voracious are they that they will take almost any bait, and I have frequently caught them with an artificial fly when fishing for trout. According to Mr. Jesse, Perch may be attracted to a certain locality by placing a number of live minnows in a glass bottle, the mouth being closed with a piece of perforated zinc to admit ingress and egress of water. A minnow as a bait is then dropped quietly among the assembled Perch, which is immediately taken. A Perch of a pound to two pounds weight may be considered a good-sized fish; instances of their reaching the weight of four, five, six, and even nine pounds are on record.

Mr. F. Buckland mentions a curious epidemic disease as occasionally occurring among Perch. In 1867 a Perch-plague is said to have destroyed hundreds of thousands of these fish in the Lake of Geneva; according to the investigations of Dr. Forel and Dr. Du Plesis this disease was caused by the presence in the blood of the fish of certain minute fungi. This epidemic is said to occur not unfrequently in England (*Famil. Hist. Brit. Fish.* p. 5.)

The flesh of the Perch is excellent, being in my opinion unsurpassed by any non-migratory fresh-water species with the exception of the eel; it more nearly resembles the sole than any other fresh-water fish in the quality and flavour of its flesh.

Some writers speak of a deformed variety of Perch, with an elevated back and distorted tail, as occurring in Sweden, and lakes in the north of Europe, and in Llyn Raithlyn, Merionethshire. A figure of this variety of Perch may be seen in Daniel's *Rural Sports*, p. 247. Perch almost entirely white have been occasionally found, and Yarrell mentions his having received specimens from Yorkshire, which were of a uniform slate-grey colour with a silvery tint, and adds that the fish retained the peculiarity of colour when transferred into other waters. Mr. C. Pennell states that he has taken deformed Perch in some ponds near New Brighton, Cheshire, and that they are not uncommon in other neighbourhoods.

The following is the formula of the number of fin rays in the Perch:—

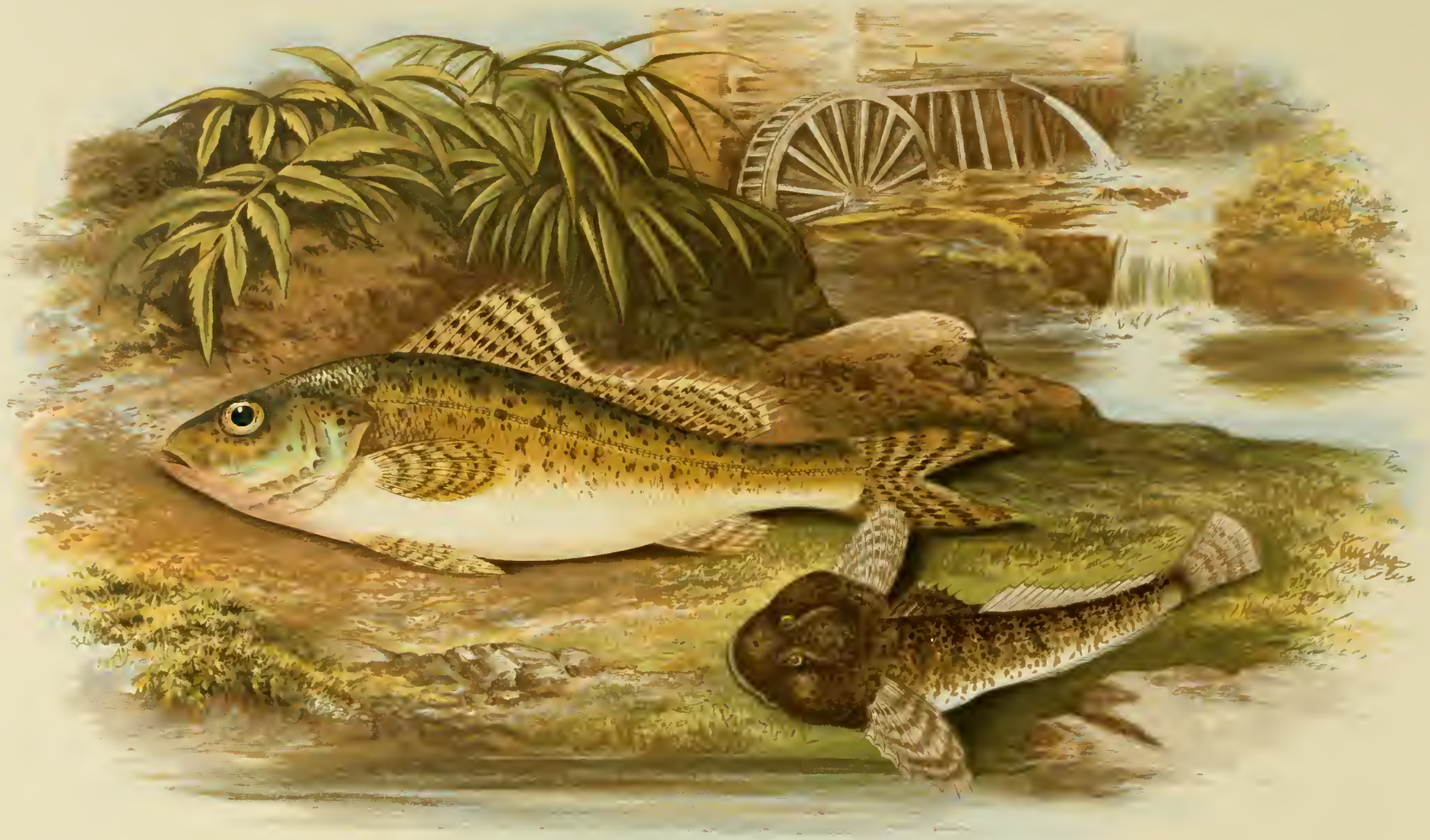
Dorsal 14—15, all spinous; 1—2 spinous + 13—14 soft.
Pectoral 14, all soft.
Ventral 1 spinous + 5 soft.
Anal 2 spinous + 8—9 soft.
Caudal or tail fin 17 rays soft.
The stomachal appendages or pyloric cœca 3.

The Perch, which is one of the most beautiful of our fresh-water fishes, has the upper part of the body a rich greenish brown, passing into golden yellowish white below; belly white; the sides are marked with about seven broad black transverse bands; the first dorsal fin is large and prickly, having a black patch on the posterior part; the second dorsal and pectoral fin pale brown; ventral, anal, and caudal bright vermilion; the eye large and full, with golden irides; præoperculum notched below and serrated on the posterior edge; operculum smooth, ending in a flattened point directed backwards; branchiostegals seven; lateral line distinct, at first ascending, then gradually descending, ending at about the middle of the tail.

Our English word Perch, which is seen also in the Italian Pergesa and the French Perche, is derived from the Latin *perca*, and that from the Greek Πέρκη, from πέρκος=περκνός, "dark coloured," perhaps from the broad black transverse bands on the sides of the fish.

The figure on the plate is drawn from a fine specimen caught in the month of June.

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On the Avon, Strensham Reach.

Order I.
ACANTHOPTERYGII.

Family
PERCIDÆ.

Ruffe or Pope.

(*Acerina cernua.*)

Cernua fluviatilis,	Gesner, De Aquatil. p. 191; Willughby, p. 334.
Perca fluviat. genus minus,	Gesner, p. 701.
Perca cernua,	Linnæus; Bloch, pl. 53, f. 2.
Acerina vulgaris,	Cuv. et Valenc., iii. p. 4, pl. 41; Yarrell, Brit. Fish., i. p. 17; Günther's Cat. i. 72.
Aspro,	Couch, Fish. Brit. Isles, i. p. 193, pl. 41.

Characters of the Genus Acerina.—"Seven branchiostegals. All the teeth villiform, without canines; no teeth on the palatine bones or on the tongue. One dorsal, with thirteen to nineteen spines; the anal fin with two; operculum and præoperculum spiniferous. Mucifcrous channels of the bones of the skull very developed. Scales rather small."—Günther.

THE Ruffe, Jack Ruffe, Daddy Ruffe, or Pope, as this fish is called, does not appear to be noticed anywhere in the writings of the ancient Greeks and Romans. According to Cuvier, the learned Dr. John Caius (born 1510) first discovered this fish, and sent a figure of it to Gesner, who published it. Gesner, however, knew of the existence of the Ruffe from

what Belon had written before Caius sent the figure to him, and had already given a good description of it. He says that in England it was known by the name of the Ruffe, "ab asperitate dictus," and that Caius had given it, for the same reason, the name of *asprelo.*

The Ruffe is a much smaller fish than the Perch, and is common in most of the rivers and canals of the midland and some other counties of England. Couch says it is not found in Cornwall or Devonshire, in Scotland, or the Isle of Wight; nor is it enumerated by Mr. Thompson among the fishes of Ireland. In Gesner's time it was rarely found in the Thames, but at present it occurs there in greater or less numbers, as is also the case in the Cam. According to Dr. Günther the Ruffe is found in the rivers of France, Switzerland, Germany, Sweden, Norway, Russia, and Siberia. It is tolerably common in some of the canals and ponds of Shropshire, and I have had no difficulty in obtaining specimens for examination. In habits it resembles the Perch. Its food consists of small worms, larvæ of insects, small molluscous animals, etc. It is a bold biter, and affords good sport to the young angler, being readily taken with a small worm; the Ruffe being, like the Gudgeon, chiefly a bottom swimmer, the baited hook should be near the ground. No doubt the Ruffe thrives best in rivers or in ponds through which water is constantly running, and in such localities it grows well, sometimes attaining to a length of seven inches and a weight of about two ounces and a half. The finest Ruffe I ever saw were caught in a pond through which fresh river-water kept flowing, belonging to R. Masefield, Esq., of Ellerton Hall, Shropshire: a fish six inches in length was by no means an uncommon specimen.

The Ruffe, resembling in outward characters and markings both the Perch and the Gudgeon, has sometimes, but erroneously, been considered a hybrid between the two; although there is actual proof that closely allied species do occasionally, and perhaps not unfrequently, cross, this is not true of fishes so very distantly related as the Perch and the Gudgeon.

The spawning season is in April; Mr. Couch says that the roe, which is shed in large quantity, is deposited in deep water on sandy ground. Mr. Cholmondeley Pennell, on the other hand, asserts that the ova are placed among the rushes and flags at the margin of the water; with this statement also Yarrell agrees. I am not able to decide between authorities in this case, and as April is now over, I must wait for another spawning season.

The Ruffe is excellent food for the table, resembling that of the Perch, but of a shorter texture; as Dame Juliana Berners says, "it is a right holsom fysshe." Its general small size, however, prevents its being of much use in this respect; it is better adapted for a bait in Pike trolling. The spinous character of the dorsal fin of this fish does not in the slightest degree interfere with its being a good bait; the same is the case with the Perch; and it is quite untrue to assert that the Pike, dreading these dorsal spikes, will refuse to attack a Perch. For myself I prefer a small Perch to any other bait for Pike; I find it quite as attractive as Roach or Dace, and being of firmer flesh, it will last the longer on the spinning tackle.

The Ruffe (rough) derives its name from the character of the scales and the spinous portion of the dorsal fin; with this we may compare the Ruff among birds from its frill-like collar of rough feathers. The meaning of the word Pope as given to this fish is not at all clear. From the expression of "Daddy Ruff," applied to it in Shropshire, one would naturally infer that allusion in some way is made to the Pope, Papa, or Father of Rome. According to Halliwell, Pope is sometimes a term of contempt. "What a Pope of a thing" is Dorset dialect. May the reference be to the small size of the fish when compared with the Perch, "the genus minus," indeed, of old Gesner? I know not. The scientific generic name of *acerina* must come from the Latin *acer*, in allusion to the "sharp" portion of the dorsal fin. The specific name *cernua*, "with head downwards," requires explanation.

The general colour of the Ruffe is greenish olive, spotted with brown; belly white; dorsal fin continuous, not distinct as in the Perch; first part spinous, the others flexible, spotted with

brown, as is also the tail, which assumes a barred appearance; gill cover tinged with greenish pearl; head without scales. The fin rays are

Dorsal 13—15 spinous + 12 flexible.
Pectoral 13.
Ventral 1 spinous + 5 flexible.
Anal 2 spinous + 5—6.
Caudal 17.
Cœca pyloric 3, as in the Perch. Lateral line distinct.

The specimen from which the illustration was made was supplied by Mr. Masefield, of Ellerton Hall, and was taken from a canal in November, 1877.

Order I.
ACANTHOPTERYGII.

Family
TRIGLIDÆ.

MILLER'S THUMB.

BULLHEAD. TOMMY LOGGE.

(*Cottus gobio.*)

Kottos,	Aristot., H. A. iv. 8 § 9; Boïtos in Gesner De Aquat. p. 401.
Cottus,	Rondel., ii. p. 202.
Cottus gobio,	Linn.; Cuv. and Valenc.; Bloch; Yarrell, i. p. 71; Couch, Fish. Brit. Isl. ii. p. 6; Günther, Cat. ii. p. 156.

Characters of the Genus Cottus.—"Head broad, depressed, rounded in front; body subcylindrical, compressed posteriorly; head and body covered with a soft and scaleless skin; lateral line present. Two dorsals of moderate height. Pectoral rounded, with some or all the rays simple. Ventral thoracic. Jaws and vomer with villiform teeth (vomerine teeth sometimes absent;) none on the palate. Air-bladder none; pyloric appendages in moderate number."—Günther.

THIS curiously-shaped little fish, I think there is no doubt, is mentioned by Aristotle when he is speaking on the question whether fishes are able to hear; he says "there occur in rivers certain little fish, found under stones, which some people call *Cotti;* from their lying under stones people catch them by striking the rocks with stones, when the fish being stunned fall out, whence it is evident that fish have the sense of hearing." The Greek word *cottus* means a head, and the little river fish with a large head which is common under stones, can be no other than our Bullhead. Gesner has given a good description and a recognisable figure of *Cottus gobio.* This fish is found in the fresh waters of Europe, and, as Günther says, probably of Northern Asia; it occurs in almost all the fresh-water streams of Europe from Italy to Scandinavia. It is said to be common in Scotland, but according to Thompson it is not found in Ireland. Yarrell, however, mentions its occurrence about

Belfast and Londonderry. Thompson suspects there is some error in the record of this fish being found in Ireland; for it appears that other species of *Cottus*, as the Sea-Scorpion and the Father-lasher, are occasionally called Miller's Thumbs in the North of Ireland. One would suppose that if this fish was once introduced into Ireland, it would grow, thrive, and multiply in the many suitable rivers of that country. From the well-known habits of the fish to lurk frequently underneath stones, and to hide its dusky body among the gravel or sand, it would be pretty secure from the attacks of enemies. However I should not advise its introduction by any means into any waters where Trout or Salmon are found; because it is as I know a most voracious feeder, being especially fond of eggs and the newly-hatched young fry of other species of fish as well as of its own.

I dissected two females the other day, about the 15th. of April; the ovaries were full of eggs almost ready for deposition; the stomachs of the same two fish also contained a great number of their own ova as well as of several of their young newly-hatched fry. Whether the males are guilty of such infanticide I do not know; but I am positive about the females. The spawn consists of a mass of pink eggs, rather large considering the size of the fish; and this mass, which generally covers an area of about one inch and a half to two inches, and is about half an inch thick, is always deposited under stones, to which it adheres by a mucous secretion which accompanies the eggs. The depressed form of the fish's head is admirably adapted for insertion under stones, and when this has been accomplished, the female with her broad and muscular pectoral fins hollows out the sand or mud under the stone, and then, probably, turns her abdomen round and deposits her eggs. The spawning takes place in April and the beginning of May, according to my observation. Johnston and Willughby say that the female collects the spawn into little lumps on her breast, where it is covered with a black membrane until it is hatched. But I feel sure there is some mistake here; the black membrane appears to be the membranous ovisac, which is black in the Miller's Thumb. Linnæus and Fleming say the fish forms a nest on the ground and broods over it, and Blumenbach says the same. I have never found the eggs except in a mass adhering to the under side of stones; I think it probable, however, that the male fish acts as a protector to the eggs, as is the case with the Stickleback. Izaak Walton and some others assert that the Miller's Thumb continues to spawn for several months. I have never found the eggs but in the spring of the year.

I am told by one or two persons who have eaten this fish that it is very good indeed; when the head is excluded, however, there is but little left to eat. It is occasionally eaten in Italy, and according to Pallas it is used as a charm against fever by some persons in Russia; others "suspend it horizontally, carefully balanced by a single thread, and thus poised, but allowed at the same time freedom of motion, they believe this fish possesses the property of indicating, by the direction of the head, the point of the compass from which the wind blows."—(Yarrell, i. 76.) The colour of the flesh after boiling is said to be pink like Salmon; but this is not true; some of the fins occasionally turn slightly pink, but the flesh remains as white as it was before boiling.

The Miller's Thumb is supposed to resemble that organ in the miller, which is said to assume a flattened form from frequently testing the flour. The head is very large, broad, and depressed; a small curved spine on the præoperculum; the body smooth and very slimy; vent nearly midway between the snout and the tip of the tail; body mottled with light and dark brown; belly white; sides below lateral line spotted with black; the lateral line very straight; first dorsal often fringed with orange red; teeth small, villiform in both jaws and on the vomer; irides yellow; pupils bluish black.

The usual length of this fish is about four inches; one of five inches would be above the average. The Miller's Thumb having the first dorsal fin with spines projecting above the membrane is placed in the Acanthopterygian order; but the spines are quite blunt, and

there are none which are able to pierce the skin, like some of the fins in the Perch and Ruffe.

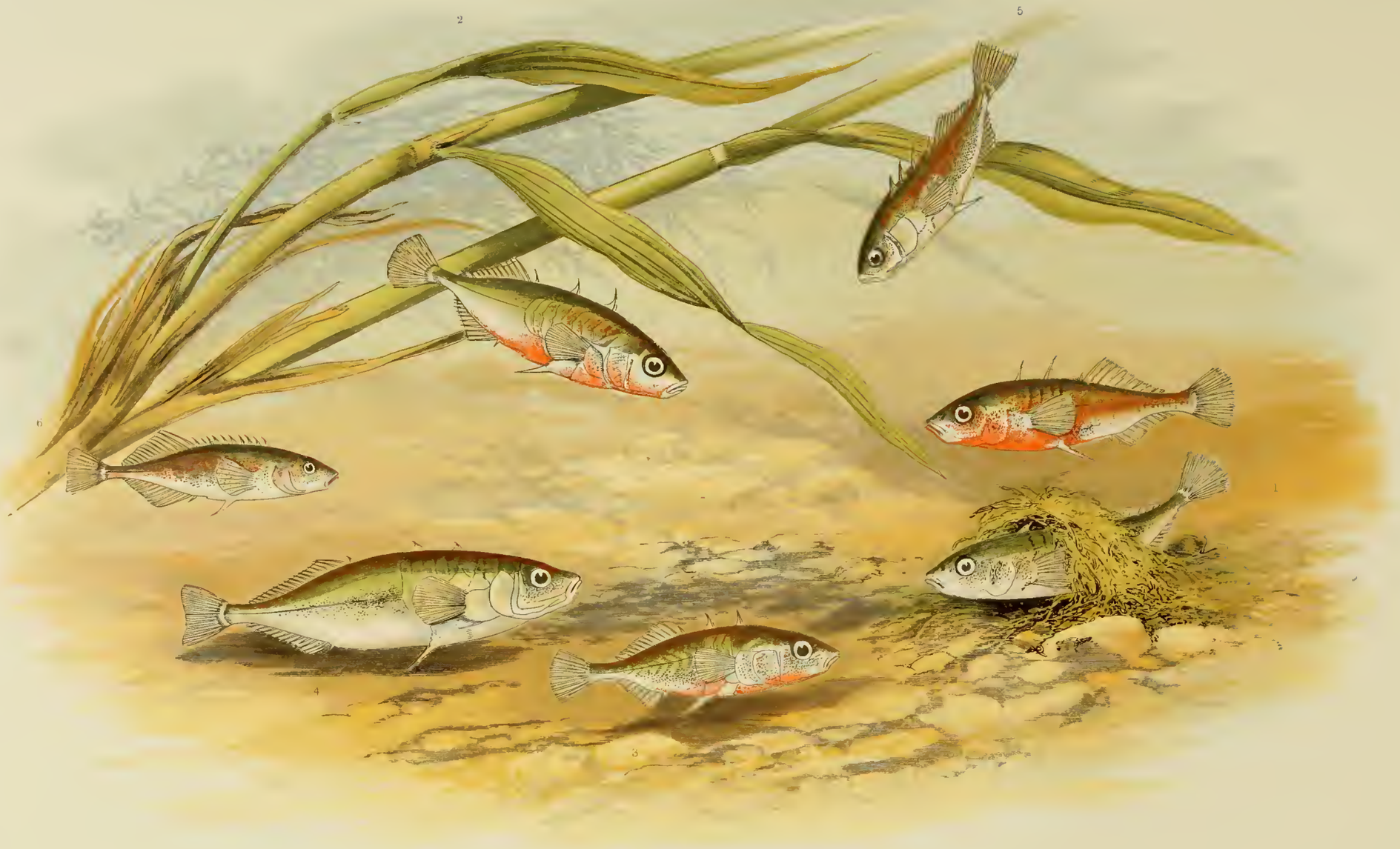
The fin-ray formula in specimens I have examined is as follows:—

Dorsal 6 spinous + 16.
Pectoral 11—13.
Ventral 4.
Anal 13.
Caudal 11—12.

The rays in all the fins are very thick and elastic; those of the first dorsal scarcely project above the membrane.

The Bullhead is most tenacious of life; hard blows on the head and complete evisceration I have known to be unable to cause speedy extinction of life. It resembles an Eel in this respect.

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STICKLEBACKS.

1. ROUGH-TAILED. 2 HALF-ARMED. 3. SMOOTH-TAILED. 4. SHORT-SPINED. 5. FOUR-SPINED. 6. TEN-SPINED.



Easdale, Grasmere.

Order I.
ACANTHOPTERYGII.

Family
GASTEROSTEID.Æ.

Three-spined Stickleback.

BARNSTICKLE. SHARPLIN. PRICKLEFISH.

(Gasterosteus aculeatus.)

Gasterosteus aculeis in dorso tribus,	Artedi, Spec., p. 96.
Gasterosteus aculeatus,	Lin., Sys., p. 489; Bloch, pl. 53, fig. 3; Donovan, Brit. Fish. i. pl. 11; Günther, Cat. i. p. 2; Couch's Fish. Brit. Isles, i. p. 167.
Gasterosteus trachurus,	Yarrell, i. p. 90.

Characters of the Genus Gasterosteus.—"Form of body elongated; eyes lateral; cleft of mouth extending on the sides of the muzzle, oblique; villiform teeth in both the jaws and on the pharyngo-branchials, none on the palate or the tongue. Three branchiostegals. Opercular bones not armed; infraorbital arch articulated with præoperculum; parts of the skeleton forming external mails. Scales none, or in the form of scaly plates along the side. Isolated spines before the dorsal fin; ventral fins abdominal, but pubic bones attached to the humeral arch; ventral with one strong spine, and generally with another single short ray. Swim bladder simple, oblong; cæca pylorica in small number."—Günther.

THE generic name of *Gastreosteus*, from *gaster*, "the belly," and *osteon*, "a bone," has reference to the strong spiny ventral fin with which the fishes of this family are armed. Though

generally of a small size, the Sticklebacks yield to none in point of interest. There are four well-marked British species, namely, the *G. aculeatus* (three-spined), *G. spinulosus* (four-spined), *G. pungitius* (ten-spined), and the *G. brachycentrus* (short-spined); the other so-called species, as the *G. gymnurus* (smooth-tailed), *G. semiarmatus* (half-armed), and *G. trachurus* (rough-tailed), are probably merely varieties of the *G. aculeatus*.

Our commonest species, the Three-spined Stickleback, is generally an inhabitant of fresh water, and is to be found in ditches, shallow streams, ponds, and canals, but it also occurs in salt and brackish water. If a specimen be suddenly transferred from a fresh-water aquarium to a salt one, this little fish does not seem the least affected by the change, except that it does not quite accommodate itself all at once to the greater buoyancy of the salt water. According to Nilsson these fish are caught in incredible numbers in the Baltic about the middle of November, when they assemble on the coasts of that sea, and are taken by fishermen in boat loads. They are boiled, and the oil they contain is skimmed off the water: a bushel of fish is said to yield two gallons of oil. The refuse is spread over the ground for manure.

The food of the Stickleback consists of small worms, larvæ, and the small crustacea, as the *cyclops*, *cypris*, and *daphnia* among the Entomostraca, and the young of the fresh-water shrimps *(Gammarus pulex)*, and water wood-lice *(Asellus aquaticus)*; but so voracious and bold is this little fish that it will attack almost any living thing. Thompson mentions that a small party of *G. spinulosus*, the Four-spined Stickleback, was observed near Belfast in the act of killing a horseleech, whose head they immediately devoured. I remember some years ago keeping a small Pike in the same vessel with a number of Sticklebacks, and I shall never forget the persistence with which first one and then another of these fish attacked the Pike's tail. Occasionally the larger fish would retaliate and try to swallow one of its tormentors, but the sauce piquant of those formidable spines always proved too potent. After a few violent shakings of the head, the Stickleback was forcibly ejected from the cavernous jaws of its would-be devourer. The result of these repeated attacks on the Pike's tail was a gradual diminution of that organ, and I, feeling sorry for the victim of these cowardly attacks on the rear, took him out of the aquarium and turned him into a pool of water. Sticklebacks are very injurious to the eggs and fry of other fish, and must therefore be carefully excluded from Trout preserves; it is, however, no easy matter to get rid of these little pests when they have once established themselves in a fish-pond. Perhaps the most curious and interesting point in the natural history of these fish is their habit of making a nest and watching over the eggs and young fry. The season for observing this habit is in the month of May. The nest is composed of decayed fibres of aquatic plants, and matted together into a mass more or less round, and placed at the bottom of the water partly covered by the mud or sand; three or four circular holes are to be seen at the top of the nest; the eggs are an aggregated mass of a brown colour, and of the size of small shot. Until pointed out, a Stickleback's nest is a difficult prize to discover, but when once the form has been well impressed on the eye, detection of any number of nests is an easy task. The male fish alone protects the nest; if it were not for his fatherly care, I suspect that the race of Sticklebacks would in time become extinct, the ova and young fry falling easy prey to the other members of the family.

Some years ago I had an opportunity of observing how necessary for the protection of a young Stickleback family is the presence of the male parent. I noticed a brilliant fish hovering over his nest, and fanning the water incessantly with his fins. Having captured him, I placed him with one or two others into my collecting bottle. Here I kept him for about half an hour, whilst I amused myself by watching the manners and customs of the fish in their natural haunts. My eye was soon arrested by the spectacle of a large crowd of hungry marauders in the shape of other Sticklebacks of all ages and both sexes that had gathered around the nest of the very parent whom I had a prisoner in my bottle. They rushed at the nest like terriers at a badger, and began to pull it in pieces, knowing there

was something good inside. Conscience-stricken that I was the author of this terrible catastrophe—for as long as the father-fish was present to protect his property the alien cannibals dared not approach—I restored my prisoner to the water, and gently put him in over the spot where about thirty remorseless strangers were devastating the nest and devouring the contents. For the space of about half a minute my liberated captive hardly seemed to know where he was, or what he had been doing. Soon, however, he collects his scattered senses, and discovering the appalling nature of the fact, rushes to the rescue; first one and then another invader is attacked, and compelled to beat a hasty retreat, and wonderful to relate, in the space of about ten minutes not a foe was to be seen, and the brave defender was left in undisturbed possession of the field. What was to happen next? The conqueror surveys the ruined state of affairs,

"Haec loca vi quondam et vastâ convulsa ruinâ."

and hastens to repair the fearful breaches which the besiegers had made. This he does by bringing mouthfuls of weed and bits of rotten twigs and other things, which he places upon the nest, using his nose to hammer the materials together.

The observation of these fish when confined in an aquarium is attended with as much delight as in their native ponds. The development of the ova may be watched under the microscope—not however so readily as in a Perch's eggs—and the little occupants be seen to jerk about their tails some time before they leave the vitelline membrane. Strange, undeveloped things in their rudimentary mouth and vitelline sac adhering to the abdomen, they cannot help attracting attention and exciting curiosity. For the first few days the little fry are seen close to the nest, lying for the most part on their sides inactively; but as they grow they become more vigorous, and anxious to see something of the world. But the father-fish is slow to encourage such juvenile desires, for is he not well aware that danger lurks on every side? And so, as I myself have seen, should some little occupant of the nursery, moved by piscine curiosity, stray away a little too far from the paternal abode, "does his father know he is out?" Yes, indeed, very soon, and after him he hies, seizes the young truant in his mouth, as a cat would her kitten, and shoots him out right upon the nest.

I have no personal knowledge of the several varieties of *G. aculeatus;* they are thus described by Günther:—

G. gymnurus.—"Four or five scaly plates above the pectoral fin, the remainder of the body naked. Middle and southern parts of Europe, England, France, South Germany, Baltic." This appears to be *G. leiurus* of Yarrell (i. p. 95), and the Quarter-armed Stickleback of Parnell (*Fishes of the Frith of Forth*, p. 190, pl. 25).

G. semiarmatus.—"The front part of the side with a series of ten to fifteen scaly plates. France, Belgium, England."

G. semiloricatus.—"The series of scales reaching to the front end of the caudal keel. France, Ireland." (See Thompson's *Nat. Hist. Ireland.*)

G. trachurus.—"The sides of body and tail entirely covered with a series of scaly plates. North parts of Europe, North Germany, England, France." This is the general type of *aculeatus.*

The fin rays in *G. aculeatus* are

Dorsal 3 spines + 10—12.
Pectoral 10.
Anal 1 spine + 8—9.
Ventral 1 spine + 1.

THE TEN-SPINED STICKLEBACK, (*G. pungitius,*) a well-marked species, is one of the smallest of British fishes. Though generally distributed, it is not nearly so common as the Three-spined. I occasionally obtain specimens from the ditches on Preston-Weald Moors,

Shropshire; but I have not had much opportunity of studying the habits of this little fish. It is nidificatory like the Three-spined, and probably the rest of the family. It is found in many of the creeks near the coast, and is said to ascend the rivers in the spring to spawn; but like the foregoing species, it is often a permanent resident in our fresh-water ditches and ponds. Sticklebacks are frequently caught with whitebait or young herrings in the lower portion of the Thames, and I have occasionally found some of these little fish on my plate cooked with whitebait. The Ten-spined is distinguished from the rest by having its sides quite naked, or free from lateral plates. It is usually about one inch to nearly two inches in length; the general colour is olive green on the back; belly and sides silvery white, with little black specks; the fins are pale yellowish white. It is sometimes called the Tinker, but wherefore I know not. The fin ray formula is

Dorsal 10 spinous + 9.
Pectoral 11.
Anal 1 spinous + 9—10.
Ventral 1 spinous + 1.

The Four-spined Stickleback (*G. spinulosus*) appears to be very rare. It was first discovered by Dr. J. Stark in a pond near Edinburgh in 1830. It is the smallest of all the species, being not more than one inch and a quarter in length. Dr. Stark kept some of these diminutive fish in tumblers, and fed them with small leeches and aquatic larvæ. He found them quite as voracious and even more pugnacious than the three-spined species. The specimens in the British Museum are from the Isle of Arran and Berwick. The fin rays are as follows:—

Dorsal 4 spinous + 8.
Pectoral 9.
Ventral 1 spinous + 1.
Anal 1 spinous + 8.

According to Dr. Stark the Four-spined Stickleback has all the varied colours of the other species of the genus, except the bright red found in the males during the breeding season.

The Short-spined Stickleback (*G. brachycentrus*) is the largest of the family, attaining the length of three inches. It was first procured for Mr. Thompson from pools along the margin of Lough Neagh, Dublin, etc. He gives one English habitat, namely, Stowpool, near Lichfield, whence in July, 1836, he obtained the largest example which had come under his observation (*Nat. Hist. of Ireland*, iv. p. 86). The number of lateral plates above the pectoral fin in this species agrees nearly with *G. aculeatus* var. *gymnurus*, but the spines, as the specific name indicates, are very short. The fin rays are

Dorsal 3 spinous + 13.
Anal 1 spinous + 9.
Pectoral 10.
Ventral 1 spinous + 1.

All the figures of the species and varieties on the Plate represent the fishes of the natural adult size, with the exception of fig. 5, which is larger than the real fish. On the right hand side may be seen a male in his bright red garb of the month of May, and a female in the act of depositing her eggs in a half-formed nest; after the eggs are impregnated the female retires, and the completion of the nest, as described above, as well as the guardianship of it and its contents, devolves entirely upon the male.

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On the Brathay.

Order IV.
PHYSOSTOMI.

Family
CYPRINIDÆ.

Carp.

(Cyprinus carpio.)

Kuprinos,	Aristot., H. A., iv. 8 § 4; vi. 13 § 2; viii. 20 § 12.
Cyprinus,	Pliny, Nat. Hist. ix. 51; Gesner, De Aquatil., p. 309.
Carp,	Willughby, H. Pisc. p. 245; Couch's Fish. Brit. Isles, vol. iv. p. 4.
Cyprinus cirris quatuor,	Artedi, Syn. p. 25.
Cyprinus carpio,	Lin., Syst. Nat. i. p. 525; Donovan, Brit. Fish. v. pl. 110; Yarrell, i. p. 349; Günther's Cat. vol. vii. p. 25.

Characters of the Genus Cyprinus.—"Scales large; dorsal fin long, with a more or less strong, serrated, osseous ray; anal short. Snout rounded, obtuse; mouth anterior, rather narrow. Pharyngeal teeth 3. 1. 1—1. 1. 3, molar-like. Barbels four."—Günther.

THE Carp was known to Aristotle under the Greek name *Κυπρινος*. He speaks of it as a river fish without a tongue, but having a fleshy roof to its mouth; as producing eggs five or six times a year, especially under the influence of the stars; as having eggs about the size of millet seed; and as being occasionally struck by the dog-star when swimming near the surface. Aristotle nowhere tells us whether the flesh of the Carp was used as food; Athenæus, however, speaks of it as excellent in the quality of its flesh, and quotes Dorion as

enumerating the Carp among lake and river fish.—"A scaly fish (*lepidotus*) which some people call the Cyprinus." (*Deipnosoph*, vii. 82.) From the Cyprinus being mentioned by Aristotle as having a soft fleshy palate (popularly but erroneously called "Carp's tongue,") and by Dorion in Athenæus as being especially scaly, there is I think no reason to doubt that this fish was known to the ancient Greeks, and as Athenæus says, was eaten by them.

The Common Carp is an inhabitant of the temperate parts of Europe and Asia. It has been long domesticated, and as Günther observes, it has degenerated into many varieties. It was probably introduced into this country, but neither the period when nor the locality whence it was first brought is definitely known. Cassiodorus, a writer of the sixth century, is the first to make use of the term *carpa;* he speaks of it as being delicate and costly, and supplied to princes' tables, and as being produced in the Danube. Writers of the thirteenth century designated this fish by the Latin terms *carpera* and *carpo*. "The Carpo of Cæsarius," says Beckmann, (*Hist. of Invent.*, ii. p. 51, Bohn's Ed.), "appears to have been our Carp, because its scales had a very great resemblance to those of the latter; for we are told.....that the devil, once indulging in a frolic, appeared in a coat of mail, and had scales like the fish *carpo*." The *carpera* of another mediæval writer, Vincent de Beauvais, certainly denotes the Carp, as he speaks of this fish's craft in avoiding nets and rakes, and of its springing out of the water and leaping over the nets. According to Linnæus, Carp were first brought to England about the year 1600; but he is certainly wrong here, because Dame Juliana Berners, in her book on angling, published in 1486, mentions the Carpe. It is "a daynteous fysshe, but there ben but few in Englonde, and thereforre I wryte the lesse of hym. He is an evyll fysshe to take, for he is so stronge enarmyd in the mouthe, that there maye noo weke harneys hold hym." Now since the name of Carp is not to be found in the Anglo-Saxon Dictionary of Ælfric, Archbishop of York, who died in 1051, and since it is spoken of by Dame Berners in 1486 as being a rare fish, it is probable its introduction into England would be at some date between the years 1051 and 1486. The Carp is once mentioned by Shakspere, namely, in *As You Like It*, Act v, sc. 2.

But from what country Carp were originally introduced into England it is impossible to say. Webster, in his Dictionary, says they first came from Persia, but I know not what may be his authority. When once established they would multiply fast, for they are most prolific, and being entirely hardy and tenacious of life, they could readily be transported from place to place. "Towards the middle of the sixteenth century," says Dr. Badham, "there was scarce a country unacquainted with Carp; in many, stews on a vast scale were stocked exclusively with *Cyprini*, and thus an unfailing supply of orthodox diet for Lent and meagre days was never wanting in larder or pond."

Carp thrive best in temperate and southern climates; when transported to northern parts they are said to decline in size. Carp spawn as a rule at the beginning of June, but the time is in some measure dependent upon the state of the weather. They prefer a warm sunny day, when a female, followed by two or three males, may be readily seen among the various aquatic weeds upon which the little scattered eggs, like poppy seeds, are deposited. They are said to be capable of spawning when three years old. It is not an unusual circumstance for Carp to retain the spawn within the ovary for years; they thus become enormously large and uncomfortably distended. It is thought that they do not always or generally get rid of the spawn at one time, but that they continue occasionally to spawn for four or five months.

The food of the Carp consists in a great measure of the soft parts of aquatic plants, and the growth of algæ, such as *desmideæ* and *diatomaceæ*, with which the plants are often overspread, though it will also eat worms, insect-larvæ, etc.: even small fish are said to be sometimes eaten. From the form of the throat-teeth, which have worn-down crowns, resembling the crowns of the molar-teeth of a quadruped, it would appear that the food of the Carp

consists mainly of vegetables, and that portions of vegetable food are returned to the throat and remasticated by these pharyngeal grinders. In cold wintry weather the Carp is more or less dormant in the mud, like many other leather-mouthed vegetable fish-feeders. I have on several occasions examined the stomachs and intestinal tract of Carp in the winter season, but never found a vestige of any kind of food in them. Carp are perhaps the most wary and shy of all fish, difficult to take by angling, and clever in avoiding the leads of the net by burrowing under them in the mud, and in leaping over the corks. At the same time they may be readily tamed, and taught to take their food from the hand.

The Carp is believed to be a very long-lived fish; Gesner mentions an instance of one living to be a hundred years old; and Buffon speaks of one living in his time of the age of one hundred and fifty years; but though there is nothing improbable in this supposition, further confirmatory evidence of this extreme longevity would be desirable. The size of Carp varies according as the locality is favourable for their growth. Yarrell says that Carp have attained three pounds weight by their sixth year, and six pounds before their tenth year; they are therefore not so rapid in their growth as some other fish, and on this account are long lived. The largest English Carp I have read of is that mentioned by Mr. Manley, in his pleasant little manual, *Fish and Fishing*. This fish was taken by a net out of Harting Great Pond, near Petersfield, in 1858; its length without the tail was thirty-four inches, the weight twenty-four pounds and a half; some of the scales were said to be of the size of half-crowns. The Carp of the White Sitch Lake, Weston Hall, the seat of the Earl of Bradford, are famous for attaining great size and weight. In a letter, dated April 14th., 1878, his lordship writes to me, "There is a portrait of a Carp at Weston caught in the last century, and mentioned in Daniell's *Rural Sports*, of nineteen pounds and a half, and we caught one the other day which I think was more." It is said that in some of the German lakes they grow to the weight of forty to fifty pounds, and that in Holland fish of twenty pounds are not uncommon. The Carp of the Larian Lake (Como), said by Paul Giovio (Jovius)—born 1483—to attain the enormous weight of two hundred pounds, and to be shot by arrows from a cross-bow, I think we may put down as a fiction.

It is well known that Carp are exceedingly tenacious of life, and will live for a long time out of water. There is no mechanical arrangement for retaining water in contact with the gills, as exists in the Apodal, the Lophioid, and Labyrinthi-branch fishes. Professor Owen associates with the branchial respiration and the apparatus of gristly arches and muscles the peculiar development of the medulla oblongata as the centre of the vagal or respiratory nerves. He writes, "the peculiarly developed vagal lobes may relate to the maintenance of the power of the respiratory organs during a suspension of their natural actions."—(*Comp. Anat. of Vert.*, i. 287.)

In quality of flesh, as an article of food, generally speaking, Carp are little estimated; in ordinary ponds, and indeed even in rivers, the flesh has always more or less a muddy flavour; but after a Carp has been kept for some time in small ponds or stews, whose water is supplied by perennial springs of bubbling fountains, the flesh has not the slightest muddy flavour about it; the vegetable growth in such stews affords ample food, and Carp become exceedingly good and very fat. Such Carp are not often to be met with; but let any connoisseur taste specimens of such fish as Mr. Masefield can supply, and he will acknowledge that the culinary art as practised and recommended by Izaak Walton is not requisite. The Carp should be merely boiled; a little melted butter and walnut pickle is a better condiment for a fountain-fed Carp than old Izaak's sweet marjoram, thyme, parsley, savory, rosemary, onions, pickled oysters, anchovies, cloves, mace, orange and lemon-rinds, and claret wine, etc., etc.

The Greek name *Kuprinos* is probably derived from *Kupris*, "Cypris," a name of Aphrodite or Venus, from the island where she was first worshipped; and applied to the Carp on account

of its extraordinary fecundity. The German Karpfen, the English Carp, are probably mere modifications of the Greek *Κυπρινος*.

The fin rays are

Dorsal 22.
Pectoral 17.
Ventral 9.
Anal 8.

The scales are large; general colour golden olive brown; head and top of the back darker; irides golden; belly yellowish white; tail forked; fins for the most part dark brown.

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CRUCIAN CARP. PRUSSIAN CARP.



Beddgelert, N. Wales.

Order IV.
PHYSOSTOMI.

Family
CYPRINID.Æ.

Crucian Carp.

(Carassius vulgaris.)

Carassius,	Willugh., Hist. P. p. 249.
Cyprinus pinna dorsi ossiculorum viginti,	Artedi, Spec. Pisc. p. 5, No. 5.
Cyprinus carassius,	Linn., Sys. Nat. p. 526; Yarrell, i. p. 355.
Crucian,	Penn., Brit. Zool. iii. p. 319, pl. 72; Couch, Fish. Brit. Isles, iv. p. 28.
Carassius vulgaris,	Siebold, Süsserwasserfishe, p. 98; Günther's Cat. vii. 29.

Characters of the Genus Carassius.—"This genus differs from *Cyprinus* in being without barbels; its pharyngeal teeth are compressed in a single series, 4—4. Temperate Asia and Europe. Domesticated and degenerated into numerous varieties."—Günther.

THE Crucian Carp derives its name from the German word for this fish, namely, *die Karausche*, from whence also the Latin Carassius has been formed. Lacépède calls it the Hamburgh Carp, and some of our Thames fishermen know it by the name of the German Carp. Probably this fish was originally introduced into our own country from Hamburgh, for it is referred to by Linnæus as being called, in the Transactions of the University of Upsal. by the elder Gronovius *Cyprinus Hamburgher*, as the locality where perhaps it was best known.

The Crucian Carp was occasionally obtained by Yarrell from the Thames, between Hammersmith and Windsor, where it sometimes attains a considerable size, and weighs a pound and a half. It has been introduced into fishponds by various gentlemen interested in pisciculture, and where the water is constantly supplied by running streams, this fish thrives well; and although its flesh cannot be considered dainty food, yet good well-nourished specimens are by no means to be despised. According to Ekström the Crucian Carp is common in all parts of Scandinavia, inhabiting muddy and grassy lakes. Its spawning time is said to be in May and June, and the eggs to be deposited on weeds. Like many of the species of this family, the Crucian is eminently retentive of life, and will live for a long time either without water or in water whose impurities would poison other fish; it also manages to exist entirely without food for months, though, as may be supposed in such a condition, it grows very thin. It is sometimes called the Bream Carp, because the general form of the fish is flat and bream-like.

The whole length of the specimen before me, from the snout to the origin of the tail, is six inches and a half; the greatest depth at the origin of the dorsal fin, which is in a line with the origin of the ventral, is three inches; the tail is slightly forked, but many specimens have the tail nearly square. The lateral line, proceeding from near the top of the gill-opening to the middle of the tail, is straight, and has thirty-four punctured scales. The back is of a bronze colour, with slight reddish tinge; below the lateral line the sides are light golden yellow, each scale being minutely dotted with black; the pectoral, ventral, and anal fins reddish brown; the tail is slightly red; the back is very much arched; the irides golden yellow, with a tinge of red; the pupils blue; the first ray of the dorsal and anal fins is serrated on the posterior edge; the scales are large.

The fin-ray formula in this specimen is

Dorsal 20.
Pectoral 14.
Ventral 9.
Anal 8.

The specimen figured was supplied by Mr. Masefield, of Ellerton Hall.

PRUSSIAN CARP.

(Carassius vulgaris, var. *Gibelio.)*

THE Prussian Carp, or Gibel Carp, which by Yarrell and some other ichthyologists has been considered a distinct species, is by other authorities, as by Günther, considered merely as a variety of the Crucian. Whether this fish be entitled to rank as a distinct species, I will not pretend to say; at any rate if not specifically distinct, the Prussian Carp is a well marked variety. The Prussian Carp is the *Cyprinus gibelio* of Bloch, Lacépède, Yarrell, Couch, and other writers; the specific name of *gibelio*, from the German Giebel, "a gable" or "ridge of a house," would seem to imply that the term was originally given to the Crucian variety, whose back rises abruptly from the head, and forms a prominent ridge; by modern ichthyologists, however, it is now employed to designate the Prussian Carp.

This variety is far better known than the Crucian, being not uncommon in some parts of the Thames, and abundant in the ponds and rivers of several of our English counties. I

believe that the Prussian Carp is common in the Norfolk Broads, where it grows to a good size: it is said to have reached the weight of two pounds. The spawning time is about the end of April or early in May. It is said to be rather a shy biter, and to afford but little sport to the angler. Like the Crucian it is very tenacious of life, and has been known to live out of water for the space of thirty hours. The flesh is said to be white and agreeable, but I have no personal acquaintance with it in this respect. The head is obtuse, body rather short and thick, the tail forked. In a typical specimen of the *C. carassius* var. *gibelio*, a difference from the Crucian will be seen in the less depth of the body, which is more Carp-like than Bream-like, a blunter head, less elevated back, and the caudal fin more decidedly forked; but even in the Prussian Carp varieties seem to exist.

Hybrids are said to be common between the ordinary Carp (*Cyprinus carpio*) and the Crucian wherever the two fish are kept in a domesticated or semi-domesticated state. Specimens may be seen in the British Museum. One of these hybrids is thus described by Günther —"It resembles the Carp in having four barbels, which, however, are much less developed and smaller. The pharyngeal teeth generally in two series (4. 1—1. 4), sometimes the inner tooth is absent, or another tooth indicates the third series of the Carp. The serrated ray of the dorsal and anal fins varies in strength, being sometimes very feeble."

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GOLDEN AND BRONZE CARP



On the Avon.

Order IV.
PHYSOSTOMI.

Family
CYPRINIDÆ.

Golden Carp.

(Carassius auratus.)

Cyprinus auratus, Linn. Syst. Nat., i. p. 527; Yarrell, i. 358; Günther's Cat. vii. p. 32.

Goldfish, Pennant, Brit. Zool., iii. p. 327.

Cyprinus telescopus, " *quadrilobus*, } Lacépède, v. pl. 18, figs. 2 & 3.

THE Golden Carp, or Goldfish, with the silver and bronze coloured specimens, has its original home in China and Japan. It is subject to as much variation as its western representative, the Crucian Carp, or *Carassius vulgaris*, of which, according to Günther and other ichthyologists, it is merely a domestic variety; "although numerous examples of the Crucian and Goldfish are exactly alike in the shape of the body, the western species appears to have the body more elevated than the eastern, which also has less longitudinal series of scales above the lateral line."—(Günther.) The Goldfish has been domesticated in China for ages, where, as Couch observes, it has contributed to the amusement of the higher classes by its lively actions in luxurious captivity; perhaps no other fish is more subject to variation both in shape and colour, and none more brilliantly beautiful than the vivid golden varieties. The Chinese

collect the spawn from the rivers and sell it to merchants, who send it to different parts of the country to be propagated in small ponds, or kept in glass or porcelain vessels in the houses of the rich.

The date of the introduction of these "sportive" fish into England is uncertain; 1611, 1691, and 1728 are each recorded as the year in which they were brought over; it was not, perhaps, till the year 1728 that Goldfish became generally known, when they were brought over in large numbers and presented to Sir Matthew Decker, Lord Mayor of London, who distributed them to various friends over the country. The Goldfish appears to have been introduced into Portugal at an early period; it is now completely naturalized in many of the waters of that country, and a great number of these fish, so commonly exposed for sale in the well-known glass globes of the London and other dealers, have been and are now, I believe, brought into England by trading vessels from Lisbon and other Portuguese towns. In France the Goldfish is said to have been unknown till the days of Louis XV., whose mistress, the Marchioness de Pompadour, had received some as a present.

The temperature of the water has a marked effect in influencing the colour of the Goldfish; in ordinary ponds of this country the usual and prevailing colour is bronze; the golden colour is induced by a warm temperature of the water. "It is a well-known fact that in manufacturing districts where there is an inadequate supply of cold water for the condensation of the steam employed in the engines, recourse is had to what are called engine-dams or ponds, into which the water from the steam-engine is thrown for the purpose of being cooled; in these dams the average temperature of which is about eighty degrees, it is common to keep Goldfish; and it is a notorious fact that they multiply in these situations much more rapidly than in ponds of lower temperature, exposed to the variations of the climate. Three pairs of this species were put into one of these dams, where they increased so rapidly, that at the end of three years their progeny, which were accidentally poisoned by verdigris mixed with the refuse tallow from the engine, were taken out by wheelbarrows-full. Goldfish are by no means useless inhabitants of these dams: they consume the refuse grease which would otherwise impede the cooling of the water by accumulating on its surface."—(Dr. Edward's *Influence of Physical Agents on Life*, Note, p. 467.)

The question as to the influence of temperature in producing changes of colour, or modifying form, or producing death, is an interesting one. The late Dr. John Davy has published some observations on the vitality of fishes, and on the degree of temperature fatal to them, well worth studying. His experiments on the Goldfish are expressed in a short paragraph, which I will quote.—"One of average size, taken from an aquarium and put into water at ninety-six degrees (Fahr.), immediately became restless, swimming about hurriedly, and making violent leaps, as if attempting to escape. Gradually it became languid, swimming on its side, the caudal fin seldom acting. After a few minutes, when the water had fallen to ninety degrees, it appeared to be motionless: the pectoral fins and the opercula were the last that ceased to act. Now transferred to water of seventy degrees, it rapidly revived, the gills first acting. After an interval of about an hour, it was put into water at ninety-three degrees. This temperature it bore pretty well at first, gradually it became languid, swimming on its side. As the water cooled, its languor abated; and when the temperature had fallen to eighty-eight degrees it had resumed its natural position."—(*Physiological Researches*, p. 301.) From this experiment it would appear that a temperature of about eighty or eighty-eight degrees is well suited to the Goldfish, and that at such a temperature it assumes a brilliant golden, silver, orange, or silver mixed with gold, but that at a temperature of ninety-six degrees the Goldfish will die; such a high temperature would probably be fatal to all other kinds of fish. The statements made by travellers that fish are able to live in water so hot that a man could not bear his hand therein for a single minute must, one would suppose, be incorrect. A temperature of one hundred and fifteen degrees was found by Dr.

Davy to be hardly bearable to his hand, and that of one hundred and twenty degrees not endurable. It is incredible, therefore, to think that a fish could live in a temperature of one hundred and eighty-seven degrees, as recorded by Sonnerat; for, as Dr. Davy remarks, such endurance would imply a different organization from that of fishes generally, when we keep in mind the simple fact that the serum of their blood is coagulated by a temperature of about one hundred and sixty degrees. I must refer any reader interested in these points to Davy's *Physiological Researches* and to Dr. Edward's work on the *Influence of the Physical Agents on Life*, p. 56, 57, Hodgkin's and Fisher's Translation.

The Goldfish presents us with many varieties of form; sometimes the dorsal fin, which in a normal specimen occupies a considerable portion of the back, consists of only four or five rays, or the dorsal may be absent altogether, or the anal fin may be double; the caudal fin or tail may be three or four-lobed; and strangest perhaps of all, in some cases the eyes may be very large and protruding. These, I need hardly remind the reader, are the varieties of Goldfish now frequently to be seen in an aquarium under the name of Japanese fan-tails, telescope fish, etc.

Goldfish seldom exceed a length of nine or ten inches.

The specimens figured were supplied by Mr. Masefield, of Ellerton Hall.

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GUDGEON.

BARBEL.



On the Thames.

Order IV.
PHYSOSTOMI.

Family
CYPRINIDÆ.

Barbel.

(Barbus vulgaris.)

Barbus,	Auson., Id. x. 94. Gesner, Aquat. iv. p. 194. Willugh., Hist. Pisc. p. 259.
Cyprinus oblongus,	Artedi, Spec. Pisc. p. 4, No. 14.
Cyprinus barbus,	Lin., Sys. N. i. 527. Donovan, Brit. F. ii. pl. 29.
Barbel,	Pennant, Brit. Zool. iii. 312. Couch, Brit. Fish. iv. p. 16.
Barbus vulgaris,	Fleming, Brit. An. p. 185. Günther's Cat. vii. p. 88.
Barbus fluviatilis,	Agass. Cuv. Siebold, Die Süsserwasserfische p. 109.

Characters of the Genus Barbus.—"Scales of small, moderate, or large size. Dorsal fin generally with the (third) longest simple ray ossified, enlarged and frequently serrated; never, or only exceptionally, with more than nine branched rays, commencing opposite, or nearly opposite the root of the ventral. Eyes without adipose eyelid. Anal fin very short, but frequently very high. Mouth arched, without inner folds, inferior or anterior; lips without horny covering. Barbels short, four, two, or none. Lateral line running in, or nearly in the middle of the side of the tail. Anal scales not enlarged. Pharyngeal teeth 5.4 or 3.3 or 2—2 or 3.3 or 4.5. Snout but rarely with tubercles or pore-like grooves. Temperate or tropical parts of the Old World."—Günther.

THE Barbel is mentioned once only, I believe, in classical authors; in the writings of the ancient Greeks there is no mention of this fish, and Ausonius of the Latins is the only author who notices the Barbel, under the appropriate name of *Barbus*, in allusion to the four

barbules or beards with which the mouth is furnished. Ausonius speaks of the Barbel as occurring in the river Saravus, the modern Sarre, which joins the Moselle a few miles above Trien.

"Tuque per obliqui fauces vexate Saravi,
Qua bis terna fremunt scopulosis ostia pilis,
Cum defluxisti famæ majoris in amnem
Liberior laxos exerces, Barbe, natatus:
Tu melior pejore ævo." (Id. x. 90—95.)

"And thou, O Barbel, harassed by the narrow passes of the winding Saravus.....after thou hast descended a river of greater fame (Mosella) more freely dost exercise spacious swimmings."

According to the above authority the Barbel is a more acceptable article of diet when old—*melior pejore ævo;* its flesh, however, is not generally held in high esteem, though it has been for long, and is now, protected by statute law. Amongst the piscatory restrictions of Queen Elizabeth's reign it is enacted that anyone taking Barbel less than twelve inches shall "pay twenty shillings, and give up the fish so wrongfully taken, and the net or engine so wrongfully used." In France the Barbel is more esteemed as food than amongst ourselves; at Tours and other inland places, situated on rivers, as Dr. Badham remarks, '*Les trois Barbeaux*' is a well-known sign, and an abundant supply is always ready for *noces et festins* in water-cages under the bridge.

The Barbel is common in the Danube, the Rhine, and in other rivers in the warm latitudes of Europe, where it grows to a large size, and occasionally attains a weight, it is said, of forty or even fifty pounds; in this country a Barbel of fifteen pounds would be considered a very large fish. The food of the Barbel is partly of an animal and partly of a vegetable nature; its principal food, during those months when it is active, consists of the larvæ of various insects, worms and small fish. It generally keeps near the bottom of the river, and probably uses its four mouth-feelers or barbules as instruments of touch, to enable the fish to detect the nature of its food; these feelers are abundantly supplied with nerves, as indeed is the case in other fish similarly provided.

Anglers generally use ground bait to attract the Barbel to the spots where they intend to fish some hours previously. I have no experience of Barbel-fishing, but those who have been so fortunate speak of this sport, as pursued in a punt on the Thames, as most amusing. Mr. F. Buckland recommends it especially to ladies. Mr. Manley, in his *Notes on Fish and Fishing*, is free to confess that he enjoys a good day's *leger* fishing for Barbel to any other day's fishing "within reach of ordinary, or even extraordinary mortals." The Barbel I believe is exclusively, in this country at least, a river fish, but it is not found in all rivers. The Thames supplies the most abundant and largest fish; in the neighbourhood of Walton and Weybridge, two hundred and eighty pounds' weight of Barbel are said to have been taken by a single rod in one day. The Trent also affords excellent fish. It does not, I believe, occur in the Severn.

The Barbel is a strong and cunning fish, "so lusty and cunning"—to quote from the *Complete Angler*—"as to endanger the breaking of the angler's line, by running his head forcibly towards any covert, or hole, or bank, and then striking at the line to break it off with his tail." I do not know whether this has been verified by modern anglers, but Mr. F. Buckland writes, "When a Barbel is hooked, he always endeavours to strike at the line with his tail to break it." Dame Juliana Berners says of the Barbel, in her own quaint language, "It is an evil fysshe to take, for he is so strongly enarmyd in the mouth, that there may no weake harnesse holde him."

The Barbel spawns in May and June. Yarrell states that the ova, amounting to seven or eight thousand in a full-sized female, are deposited on the gravel and covered by the

parent fishes, and that they are vivified in a warm season between the ninth and fifteenth days. Couch says the spawn is discharged in a string, and entwined round some fixed object, as a stone or weed. Gesner says that the Barbel opposite his house, situated near the Danube, spawn at the beginning of August. Siebold mentions May and June as the months. The roe is supposed to be poisonous. Gesner quotes several old writers who affirm that from experiments made on themselves the roe has proved injurious as food; this appears to be alluded to in the *Book of St. Albans*, where it is said, "The Barbyll is a swete fysshe, but it is a quasi meete and a perilous for mannys body. For comynly he yevyth an introduxion to ye Febres. And yf he be eten rawe, he maye be cause of mannys death; whyche hath oft been seen." Sir John Hawkins, in a note of his edition of the *Complete Angler*, says that even the flesh of the Barbel is deleterious, for a servant of his, who had eaten part of the fish, but not the roe, "was seized with such a violent purging and vomiting as had like to have cost him his life." On the other hand, Bloch asserts that both himself and some members of his family ate of a considerable portion of Barbel roe without any disagreeable results. It is possible that in some cases the effect may be due to idiosyncrasy, or a peculiar disposition of the individual who partook of the roe, but at the same time it is not unlikely that Barbel roe may be, in itself, injurious when eaten. In the time of Sir John Hawkins, Barbel roe used to be taken by country people medicinally, as an emetic and a cathartic. Siebold (*Die Süsserwasserfische*, p. 110) on this point writes: "It is strange that although people have of old been warned against eating the spawn of the Barbel, and that frequent experiences still often occur, resulting in vomiting and diarrhæa, (it is strange) that no one has set himself the task of investigating scientifically the spawn of this common fish with a view to test its poisonous effects." Siebold's work, quoted here, bears date 1863. I know not whether since this time any attempts have been made to investigate this matter.

The Barbel, says Yarrell, in the Coat of Bar, forms one of the quarterings of the arms of Margaret of Anjou, queen of Henry the Sixth. These arms are beautifully painted in glass in the windows of a curious old manor-house at Ockwell, in Berkshire, on the banks of the Thames; thus a sort of historic interest, as Badham observes, attaches to this fish.

The flesh of the Barbel is generally pronounced to be poor and insipid; the only way to make these fish eatable, according to Mr. Manley, is to salt and dry them, "and even then," he says, "they are not much better than the bark of a tree would be subjected to a similar process." But Dr. Badham begs to assure citizen anglers, and others who may be incredulous, that these fish, simply boiled in salt and water, and eaten cold, with a squeeze of lemon-juice, will be found by no means despicable fare; he particularly commends "the head and its appurtenances."

The form of the Barbel is rather long, and narrow at the back; the length of the head, which is decidedly pig-like in form, is one fourth of the whole, not including the tail; snout much produced, lips thick; there are no mouth-teeth, but there are the usual throat-teeth of this family; eyes small; a pair of barbs above the upper lip, and one at each corner of the mouth; colour of the back greenish brown or bluish, sides yellowish, white below; tail deeply forked.

The fin-ray formula is as follows:—

Dorsal 11.
Pectoral 16.
Ventral 9—10.
Anal 8.

The specimen figured was procured from the Thames near Oxford; I am indebted to Mr. William Hine, of the Anatomical Department, Museum, Oxford, for a fine specimen for examination.

Order IV.
PHYSOSTOMI.

Family
CYPRINIDÆ.

GUDGEON.

(Gobio fluviatilis.)

Gobio,	Auson., Id. x. 134; Cuv. R. An.
Gobius fluviatilis,	Gesner, de Aquatil., p. 399.
Cyprinus gobio,	Linn., Syst. Nat. i. p. 526; Donovan, iii. pl. 71.
Gudgeon,	Pennant, Brit. Zool., iii. 310; Couch, Brit. Fish., iv. 20, pl. 182.
Gobio fluviatilis,	Willughby, p. 264; Yarrell, Brit. Fish., i. p. 371; Siebold, Süsserwasserf. p. 112; Günther's Cat. vii. p. 172.

Characters of the Genus Gobio.—"Scales of moderate size; lateral line present. Dorsal fin short, without spine, opposite to the ventrals. Anal fin short. Mouth inferior; mandible not projecting beyond the upper jaw when the mouth is open; both jaws with simple lips; a small but very distinct barbel at the angle of the mouth, quite at the extremity of the maxillary. Gill-rakers very short; pseudo-branchiæ. Pharyngeal teeth 5.3 or 2—2 or 3.5, hooked at the end. Europe."—Günther.

IT is not certain whether the Gudgeon is distinctly mentioned by the ancient Greeks, though it was doubtless known to them. It is probable that under the name of Κωβιος (whence the Latin *gobios* is derived,) Aristotle occasionally alludes to the Gudgeon. Ausonius is sufficiently descriptive, and clearly speaks of that most excellent little fish in the following lines:—

"Tu quoque flumineas inter memorande cohortes
Gobio, non major geminis sine pollice palmis
Præpinguis, teres, ovipari congestior alvo
Propexique jubas imitatus Gobio Barbi." (Id. x. 131—134.)

"Thou too, O Gudgeon, worthy of being mentioned among the shoals of the river, not greater than the two palms of the hands without the thumb; very fat, round and plumper still when thy belly is full of eggs; Gudgeon imitating the hairs of the pendent-bearded Barbel."

I suspect also that the author of the *Halieuticon* is referring to the Gudgeon in the line—

"Lubricus et spina nocuus non Gobius ulla."

"The slippery Gobio harmful with no spine."

The Gudgeon is found in such rivers and streams of this country as flow with moderate velocity, and have a sandy or gravelly bottom. These fish will also thrive in ponds through which fresh water runs; they are gregarious in their nature, and readily taken with a worm, affording capital sport in their small way, to those anglers who care more for numbers than size, and who can appreciate a most excellent food. Their spawning time is in May and June; the ova are very small, and are deposited among stones in shallow water. Yarrell states that the fry are about an inch long by the beginning of August. According to Thompson the Gudgeon is found in many of the waters of Ireland. It is not mentioned as occurring in Scotland. Is this merely negative evidence? Is not the Gudgeon an inhabitant of any of the waters of Scotland? Couch says it is known only of late in Cornwall and the western portion of Devonshire.

In point of flavour the Gudgeon approaches that of the Smelt or Sparling, and in my opinion is one of the best of fresh-water fish we possess. It is a pity, from a gastronomic point of view, that the Gudgeon does not exceed the length of six or seven inches, which is the size denoted by the "two palms of the hand without the thumb" of Ausonius.

The following is Günther's description of the Gudgeon:—"The height of the body is one fifth or nearly one fifth of the total length (without caudal); tail compressed; snout obtuse, with the upper profile convex; eye a little behind the middle of the length of the head (in adult specimens). Barbels not extending beyond the centre of the eye (in adult examples), frequently shorter. A series of round blackish spots along the lateral line, sometimes confluent posteriorly. Dorsal and caudal fins with transverse series of black dots."

The fin rays are

Dorsal 9—10.
Pectoral 15.
Ventral 8.
Anal 8.

The English word Gudgeon comes directly from the French *goujon*, that from the Latin *gobio*, which must be referred to the Greek *Κωβιος*. The expression "to gudgeon a man," *i.e.* to deceive him, may have originated from the ease with which a Gudgeon is taken by a bait, as Gay sings—

"What gudgeons are we men,
Every woman's easy prey!
Though we've felt the hook, again
We bite and they betray!"

Or it may have reference to the ease with which so delicate a morsel as a Gudgeon is swallowed. According to the French expression given by Rouchi (*Patois of the Hainault*, Wedgwood's *Etymolog. Dict.*), *Cha passe come un gouvion*, meaning "that which is easily swallowed;" so also *Faire avaler des gouvions*, "to make one believe a lie," literally "to make Gudgeons be swallowed." On this point Latham, in his *Large Dictionary*, (s.v. *gudgeon*) observes: "Of Gudgeons having been swallowed with particular ease there is no very good evidence; though there is a good deal in favour of the Loach having been so treated. The Loach is said, in most notices, to have been not unfrequently tossed off in toasts, or swallowed in a glass of wine, by the gallants of the Elizabethan period. It is suggested, then, that the *Gudgeon* when suggestive of credulity is the Loach. How much the two fishes have in common is well known. Both keep on the ground; both are marked or mottled; both have a beard or wattles."

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ROACH



On the Hodder.

Order IV.
PHYSOSTOMI.

Family
CYPRINIDÆ.

Roach.

(*Leuciscus rutilus.*)

Rutilus sive Rubellus fluviatilis,
Cyprinus iride pinnis ventralibus ac ani plerumque rubentibus,
Cyprinus rutilus,
The Roach,

Leuciscus rutilus,

Gesner, de Aquat., p. 820.
Artedi, Spec. Pisc. p. 10, No. 18.
Linn., Sys. N. i. p. 529.
Pennant, Brit. Zool. iii. p. 319; Couch, Brit. Fish. iv. 47, pl. 191; Yarrell, i. p. 399.
Fleming, Brit. An. p. 188; Siebold, Süsserwasserf. p. 183; Günther, Cat. vii. p. 212.

Characters of the Genus Leuciscus.—"Body covered with imbricate scales; lateral line generally complete, running in, or only a little below, the median line of the tail. Dorsal fin short, without stiff ray, commencing opposite, rarely behind the ventrals. Anal fin rather short or moderately developed, generally with from nine to eleven rays, rarely with eight (in small species only), and still more rarely with fourteen rays. Mouth with structural peculiarities; lower jaw not trenchant; barbels none. Pseudo-branchiæ. Pharyngeal teeth conical or compressed in a single or double series. Intestinal tract short, with only a few convolutions. Palæ- and Nearctic regions."—Günther.

THE Roach is generally distributed throughout England, Wales, and Scotland. In Ireland, however, it is said not to occur, the Rudd (*Leuciscus erythrophthalmus*), or Red-Eye, which is exceedingly common in the north of Ireland, being mistaken for the true Roach. According to Couch, the Roach is not known in Cornwall, and in Devonshire only in the lake called Slapton-Ley. Its European geographical distribution is north of the Alps.

Roach are gregarious, and swim generally in shoals; they spawn at the end of May and the beginning of June, and at this season the scales are peculiarly rough to the touch; the spawn is deposited among weeds or upon submerged bodies in immense quantities. In the Aqualate Mere belonging to Sir Thomas Boughey, Bart., Staffordshire, this spawning process is utilized in the capture of eels; certain wattle-work constructions are set up in different parts of the mere, to which the Roach resort, and upon which they fix their spawn; here large quantities of eels congregate to feed on the Roach or spawn, and are taken in wicker traps. The Roach is not in much request as an article of diet, the flesh being generally soft and woolly; nevertheless large specimens in September and October are not to be despised when nicely fried.

"The art of Roach fishing," says Mr. Manley, "rightly holds a high place in the angler's estimation. Anyone can catch the half-bred and half-starved Roach of a muddy and weedy pond, and I dare say Dame Berners spoke rightly of the uneducated fish of her day when she said 'the Roche is an easy fysshe to take.' Probably, too, Walton was justified in speaking of the Roach of his day as being 'accounted the *water-sheep* for his simplicity or foolishness.' But a river Roach, say of the Thames, or Colne, or Trent, of our era is a very different fish, and he is not to be had by any tyro. He has, too, his times and seasons, his offs and ons, and the general capriciousness of the scaly tribes, being subject to all kinds of atmospheric and terrestrial influences, which affect both the time and manner of his taking a bait. Moreover, Roach of a much-fished river, like the Thames, are highly educated, and are pretty wide awake to the fisherman's proceedings—the fixing of the punt, the plumbing the depth, and the scattering of the ground-bait. Of course the latter attracts them, and they come to see 'what's up,' and if inclined to feed they will constantly take the baited hook for an innocent morsel of favourite food. But to make a good basket of Roach, even when they are 'on,' requires very careful attention to a number of details."—(*Notes on Fish and Fishing*, p. 300.)

The usual length of a Roach is about eight or ten inches, but it is said sometimes to attain fourteen inches; a Roach of one pound in weight would be considered a good fish; but instances are on record of fish having been taken two, three, and even five pounds weight. This last fish is mentioned by Pennant, and its weight may fairly be questioned.

The food of the Roach, like other members of the family, is partly of a vegetable and partly of an animal nature. The throat-teeth are large and well developed, arranged generally in a single series; they form an important character in distinguishing this fish from its relative the Rudd; in this latter fish the teeth are minutely but distinctly serrated, which is not the case in the Roach.

The Azurine or Blue-Roach, the *Leuciscus cæruleus* of Yarrell, is probably only a variety of the Rudd. Hybrids between the Roach and the Rudd are supposed to occur, and I think there is no doubt from an examination of several specimens, that the so called Pomeranian Bream is merely a cross between the Roach and the Common Bream, as first stated by Professor Von Siebold.

The following is Dr. Günther's description of the Roach:—"Body generally somewhat elevated, its depth being about one third of the total length (without caudal). Mouth terminal, the upper jaw but slightly projecting beyond the lower. There are three longitudinal series of scales between the lateral line and ventral fin. Origin of the dorsal fin above, but not in advance of the root of the ventral. Body silvery, the lower fins generally with a red tinge in adult examples. Pharyngeal teeth 6, or 5—5, (or 6)." The position of the dorsal fin with regard to that of the ventral will at once distinguish the Roach from the Rudd; in the former the origin of the dorsal is only slightly behind that of the ventral; in the latter it is conspicuously so.

The definition of our English word Roach is far from clear. The Anglo-Saxon is *rcohche*,

which also signifies "a thornback" or "skate-fish;" this seems to bring one to the root *roh*, "rough." Possibly reference may be implied to the roughness of the fish during the season of spawning. The expression "as sound as a Roach," is supposed by some to have been originally "sound as a rock." Ray has the proverb "as sound as a Trout;" "but sometimes people will express it *as sound as a Roach;* which is by no means a firm fish, but rather otherwise; and on that account Mr. Thomas surmises it should rather be *as sound as a roche*, or rock; and it is certain, the Abbey of de Rufe, in Yorkshire was called Roche Abbey, implying that *roche* was formerly the pronunciation of *rock* here, in some places at least." (Latham's *Dict.* s.v.) That the proverb however originally referred to a fish, and not to a rock, seems probable from Ray's expression "sound as a Trout," as well as from the French saying "*être frais comme un gardon*," "to be fresh as a *gardon*," (Roach or Ide); which Littré (s.v., *gardon*) thus explains, "to have an air of freshness and health, an expression derived from the brilliancy of the scales of this fish." Littré gives another proverb, "*Fraîche comme un gardon, droite comme une perche*," "fresh as a Roach, right as a Perch."

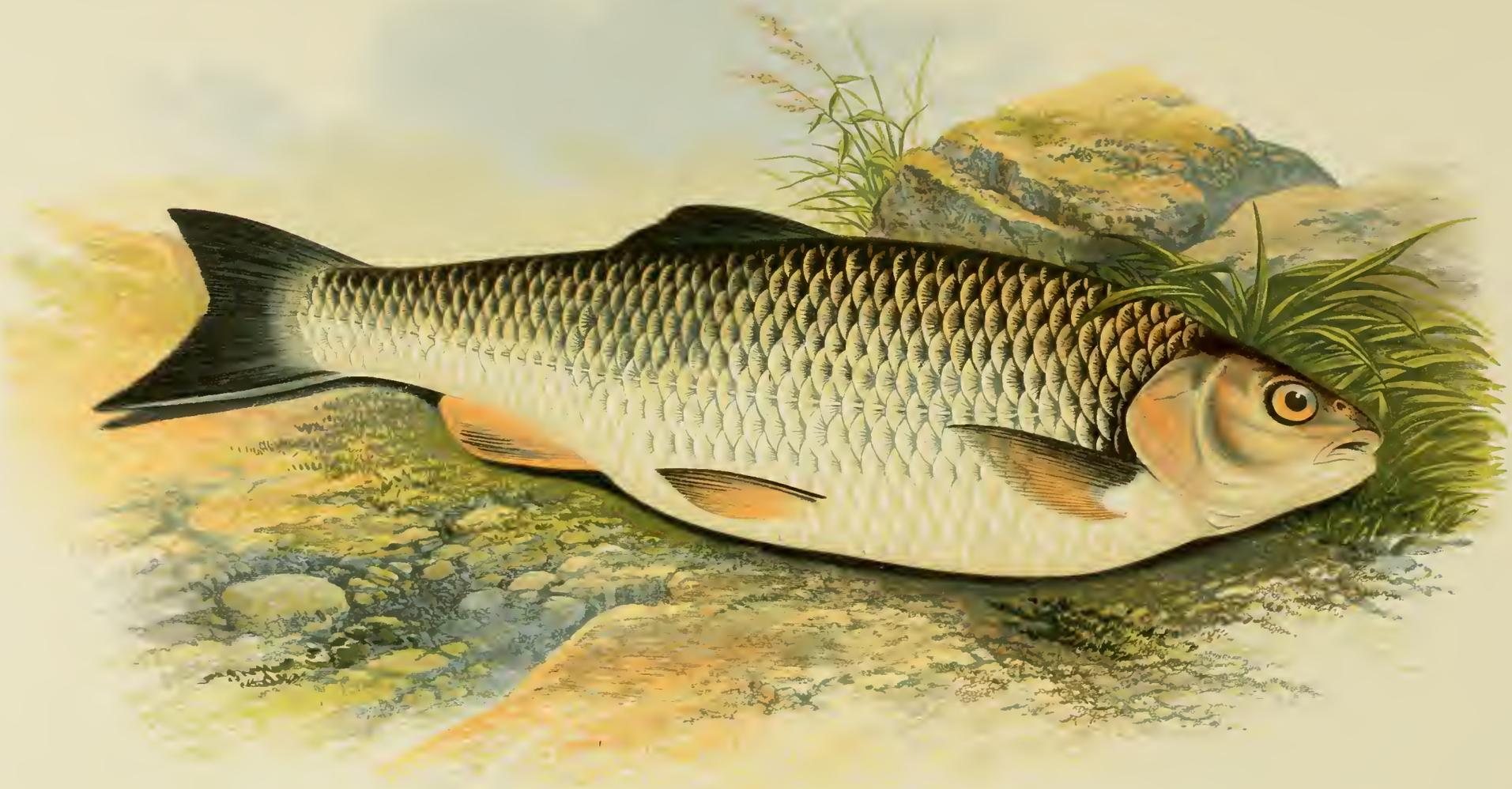
The scientific name of *leuciscus* is from the Greek *leucos*, "white," a term which we generally employ to denote the bright and silvery Roach, Dace, &c.

The fin formula of the Roach is

Dorsal 12.
Pectoral 17.
Ventral 9.
Anal 13.

The specimen figured was supplied by E. H. Reynard, Esq., of Sunderlandwick.

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CHUB.



On the Lea.

Order IV.
PHYSOSTOMI.

Family
CYPRINIDÆ.

CHUB.

(Leuciscus cephalus.)

Capito,	Auson, Id. x. 85.
Capito seu Cephalus fluviatilis,	Gesner, de Aquatil, p. 182.
Mugil fluviatilis,	Willughby, p. 261.
Chub or Chevin,	Willughby, p. 255; Pennant, Brit. Zool., iii. p. 322; Yarrell, i. p. 419; Couch, Fish. Brit. Isles, iv. p. 44.
Cyprinus oblongus macrolepidotus,	Artedi, Sp. p 7, No. 10.
Cyprinus cephalus,	Linn., Syst. i. p. 527.
C. jeses,	Donovan, Brit. Fish. v. pl. 115.
Leuciscus cephalus,	Fleming, Brit. An. p. 187; Günther, Cat. vii. p. 220.
Squalius cephalus,	Siebold, Süsserwasserfische, p. 200.

IN three short lines Ausonius, in his Idyl on the Moselle, appears to speak of the fish now under our consideration, namely, the Chub—

"Squameus herbosas Capito interlucet arenas,
Viscere prætenero fartim congestus aristis,
Nec duraturus post bina trihoria mensis." (Id. x. 85-7.)

"Among the weedy sands the scaly Chub glitters, completely stuffed in its very soft flesh with awn-like bones, a fish which will not keep for the table beyond six hours."

The large broad head of this fish implied in the Latin word *Capito*, the large scales denoted by the term *squamcus*, the woolly and exceedingly bony nature of the flesh as mentioned in the second line, and the liability to spoil by being kept, all truthfully point to the Chub as the fish of which Ausonius speaks.

The Chub is common in the deep rivers of this country, as in the Thames, the Wye, and many other streams. It prefers, as Couch remarks, "those streams in which the water flows with some considerable rapidity, along a clean bottom of sand or gravel; and so needful to its well-being is a supply of what is afforded by a current, that it is not easy to keep it alive in a tank, or within the narrow limits of a pond." This is quite true as a general rule, though I have known Chub to do fairly well in a strip of water through which there was no constant fresh-water current flowing; indeed the specimen figured was taken from such a piece of water described. It is found also in some of our canals, where the water is pretty clear and wholesome. The Chub is found in various parts of Europe, and in Asia Minor. According to Siebold it is pretty common in almost all the lakes, rivers, and streams of Middle Europe, attaining to a good size and weight of eight pounds or more, but on account of the flesh abounding in little bones it is nowhere in much repute. In the north of Scotland it is said not to occur, nor in the west of England. However, it is probable that the Chub may be artificially increased by its introduction into rivers, where it is not at present found, but its poor reputation as an article of diet is not likely to induce pisci-culturists to take much interest in it.

The spawning time is at the end of April and the beginning of May; according to Siebold, in the months of May and June, during which time the males are covered with fine granules breaking out over the body.

I have but little experience in angling for Chub, though I have occasionally caught them with a worm or an artificial fly. From an angler's point of view, according to Mr. Manley, "the Chub, as a fish for sport, is by no means to be despised, though he is not so strong, plucky, and determined as some others when hooked." The same writer says there is this peculiarity about the Chub, that no other fish can be captured in such a variety of methods and with such a variety of baits; he also recommends that the fisherman, whatever fly he uses, should attach to the bend of the hook a narrow strip of white kid, about half or three quarters of an inch long, as adding some attraction to the fly. The Chub is a wary and shy fish, choosing deep quiet holes under bushes, where it is screened from view. Its natural food is the larvæ of various insects, worms, etc., though from the presence of strong and decided throat-teeth there can be no doubt that the Chub is partly also a vegetable feeder, like the *Cyprinidæ* generally.

As to the quality of the flesh as food, the Chub is almost universally esteemed poor; I have tried it in various ways, and I must say that, in my opinion, it is not worth cooking. On one occasion I tried Izaak Walton's receipt, which is as follows:—"First scale him and then wash him clean, and then take out his guts, and to that end make the hole as little, and near to his gills as you may conveniently, and especially make clean his throat from the grass and weeds that are usually in it; for if that be not very clean, it will make him to taste very sour. Having so done, put some sweet herbs into his belly; and then tie him with two or three splinters to a spit, and roast him, basted often with vinegar, or rather verjuice and butter, with good store of salt mixed with it." I must say that I did not find the Chub—and he was a fine specimen—thus dressed "a much better dish of meat" than anglers imagine; and I never again cared to repeat the process. The French, it is said, call the Chub *un vilain*, and condemn him altogether. Mr. Francis, speaking of the Dace and Roach, recommends them to be pickled or potted, or plainly broiled, salted and peppered, a slice of butter being laid on them while hot, and says that even Chub can be eaten in this way. Mr. Manley endorses the statement of Ausonius to some extent when he says, that

Chub are to be cleaned as soon as possible after being taken, split open, and rubbed with salt or lemon, and that if anglers will insist on eating of their spoil, they must, above all, remember "that a Chub *kept for a single night uncleaned is absolutely uneatable.*"

A Chub of three or four pounds weight would be considered a good-sized fish; Yarrell states that one of five pounds is the most that he can find recorded; Mr. Cholmondeley Pennell, who has given a table of comparative weights and lengths of Chub, records, as three of the biggest fish, the following lengths and weights:—

A Chub	weighing	5lbs.	5¼oz.	measured	21	inches.
"	"	6	2½	"	22	"
"	"	7	0½	"	23	"

Our English word *Chub* has clearly been given to the fish to express the broad size of the head; it is the Anglo-Saxon *copp*, German *kopf*, the Latin *caput*, the Greek κεφαλη, the Sanskrit *kapâla;* but Mr. Manley is quite right in objecting to the term as implying the idea of a clumsy logger-headed fish, because the Chub's head does not justify such an appellation in the least; the head is certainly broad, but not at all out of proportion; and the Chub, as Mr. Francis says, "is a well-shaped, handsome-looking member of the Carp tribe," and I hope my readers, on referring to the plate, will acknowledge this fish to be so. The Latin name of *Capito* is given by Ausonius as the name of the Chub, and other writers have merely followed his nomenclature as having the claim of priority. In some parts of the north of England, as about the Eden, the Esk, the Lowther, Eamont, and other rivers, the Chub is called the *Skelly*, a term no doubt having reference to the large scales of the Chub. A very similar word, *Schelly*, is in the neighbourhood of Ullswater applied to a very different fish, namely, to the *Coregonus clupeoides*, one of the Salmonidæ, known at Bala as the Gwyniad, and at Loch Lomond as the Powan. The term Schelly, as applied to this latter named fish, may refer to its bright shining scales, or to the ease with which the scales fall off from the body when handled; with this we may compare the expression to scale a fish, or the term *shale* in geology.

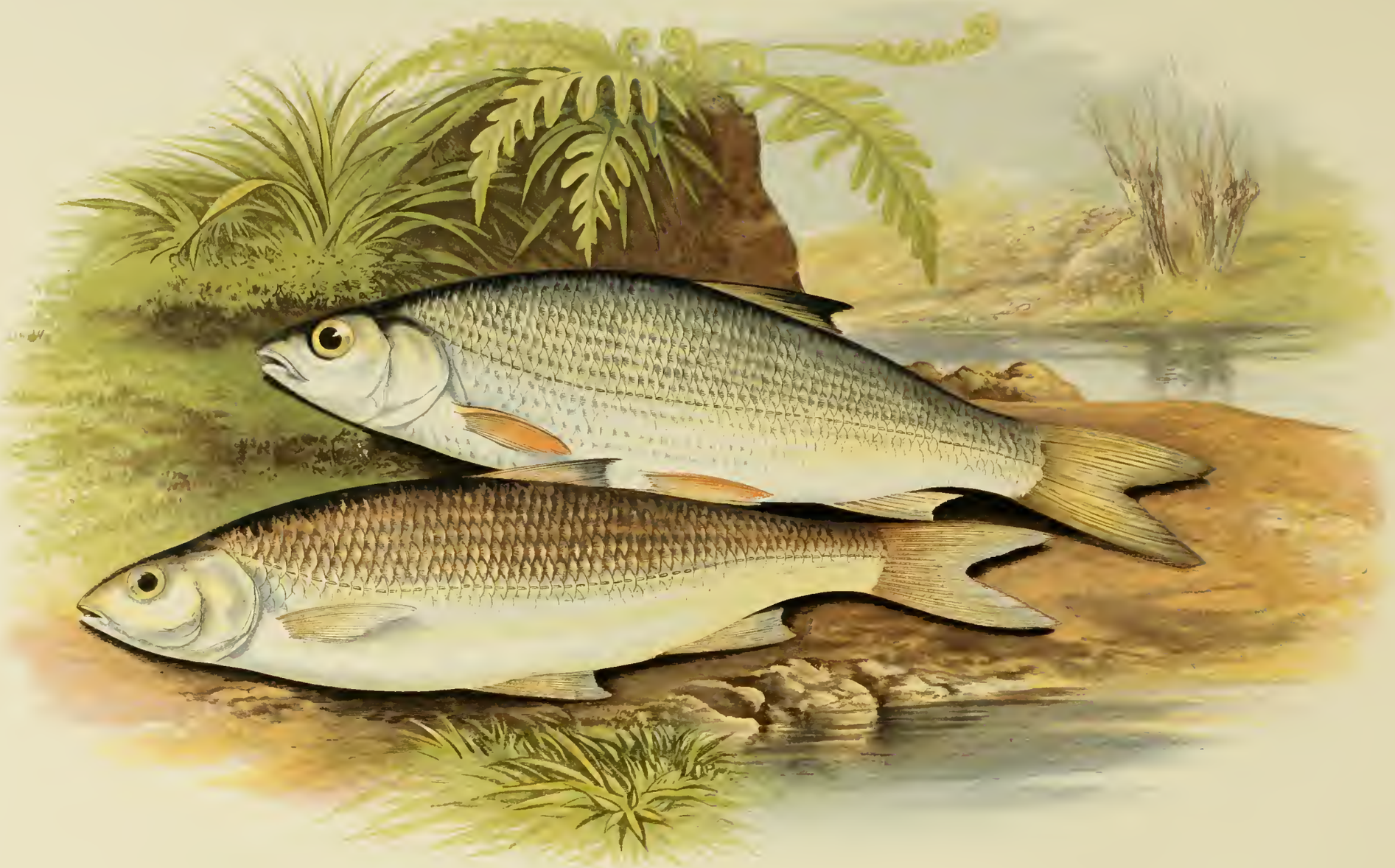
The specific distinctions of the Chub are as follows:—"Body oblong, its depth being one fourth or rather more than one fourth of the total length (without caudal). Head very broad, the width of the interorbital space being about two fifths of the length of the head. Mouth wide, its cleft extending to below the front margin of the orbit; upper jaw slightly overlapping the lower. The hindmost suborbital bone is rather larger than the first, *the width of the third much less* than that of the last. Origin of the dorsal fin opposite to the root of the inner ventral rays. Length of the ventral fin more than one half that of the head. There are three longitudinal series of scales between the lateral line and ventral fin. Coloration uniform; margins of the scales greyish. Pharyngeal teeth hooked, slightly denticulated, 5.2—2.5."—(Günther.)

The fin formula is

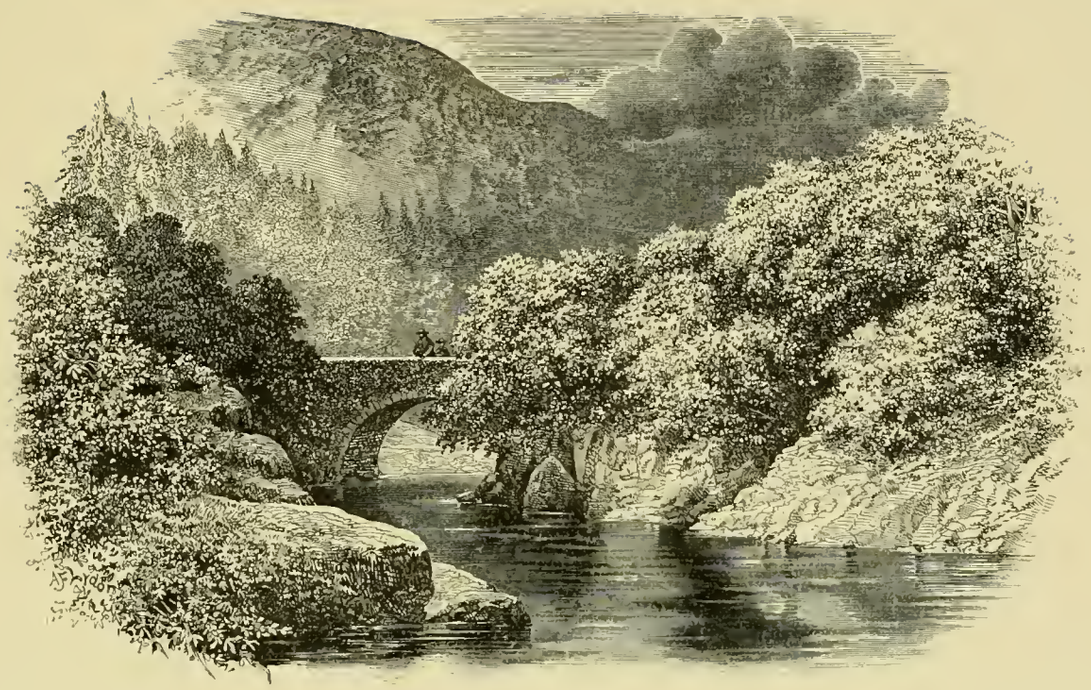
Dorsal 11.
Pectoral 16.
Ventral 9—10.
Anal 11.

The specimen figured was supplied by Mr. Masefield, of Ellerton Hall.

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GRAINING. PACE.



Pont Aberglaslyn, North Wales.

Order IV.
PHYSOSTOMI.

Family
CYPRINIDÆ.

Dace.

(Leuciscus vulgaris.)

Leucisci secunda species,	Gesner, De Aquatil. p. 26.
Dace, or *Dare,*	Willughby, Hist. Pisc. p. 260; Pennant, Brit. Zool. iii. p. 320; Couch, Fish. Brit. Isl. iv. p. 54, pl. 194.
Cyprinus novem digitorum, &c.,	Artedi, Spec. Pisc. p. 9 No. 16.
Cyprinus leuciscus,	Lacép., v. p. 572; Donovan, Brit. Fish. iv. p. 77.
Vandoise,	Bellon, p. 314; Bloch.
Leuciscus vulgaris,	Fleming, Brit. An. p. 187; Yarrell, i. p. 404; Günther's Cat. vii. p. 226.
Leuciscus lancastriensis (Graining),	Yarrell, i. p. 406.
Dobule Roach,	Yarrell, i. p. 397.
Squalius leuciscus (Hasel, Häsling),	Siebold, Süsserwasserfische p. 203.

THE Dace is one of the most elegant-shaped fish which we have; it is of a beautiful silvery whiteness, and exceedingly quick in its movements, darting like an arrow away from any person or object that may alarm it. It is common in most of the rivers and streams of Central Europe. In England the Dace is found in many of our clear waters, but it is said not to occur in Ireland or Scotland. The Dace is gregarious, like the Roach,

swimming generally in shoals; it feeds on the larvæ of various kinds of insects, as well as on the insects themselves, and on worms; its food is also partly of a vegetable nature. The spawning time is in the month of June, at which season these fish may often be seen to congregate on the weedy shallows of rivers, upon which they deposit their ova.

Dace rise freely at the artificial fly, and, as Mr. Pennell says, "make a gallant fight when hooked." They are in good condition in September and October, and though not held in great repute in a gastronomic point of view, being rather soft in flesh and full of small bones, fine specimens out of our clear rivers are not to be despised when nicely fried. The Thames fishermen catch considerable number of Dace, using a light red worm as a bait; bottom-fishing is said to be at its best in October, November, and even in December and January. The Jews have a great liking for Dace, and indeed for white fish generally, and, as Mr. Manley says, they consume them in large numbers (at least when they can get them) during their fasts. Very fine Dace are said to be produced in the New River, near Hornsey, specimens of three-quarters of a pound being by no means uncommon; according to Mr. Pennell, the people residing in the neighbourhood are said to prefer them to Trout for the table. The Dace, from its brilliant appearance, is an excellent bait in trolling for Pike, especially when the water is discoloured. The usual size to which the Dace attains is about eight or nine inches, though larger specimens are found.

The length of the specimen before me from point of nose to the bifurcation of the tail is seven inches and a half; the greatest depth is two inches; the length of the head is one inch and a half; mouth narrow, the cleft not extending as far as the front margin of the orbit, upper jaw overlapping the lower; the origin of the dorsal fin is just opposite the hind part of the root of the ventral; three or four longitudinal series of scales between the lateral line and the ventral fin; upper part of back brownish blue, or blue by angularly reflected light; below lateral line silvery white; irides white or light straw-colour; pectoral and ventral fins slightly tinged with red; anal white; caudal brown, deeply forked.

The fin rays are

Dorsal 9.
Pectoral 15.
Ventral 9.
Anal 10.

The word *Dace* appears to have been formed by what philologists term "phonetic decay" from the fuller form of *dart*, a name which, with another synonym of *dare*, is applied to the fish under our consideration. As early as the time of Gesner we learn that this species of *Leuciscus* was called the *Dard* by the Santones and Pictones (the old names for the inhabitants of the provinces of Saintonge and Poitou), because the fish moves rapidly, like an arrow or "dart." "Alia Leucisci species est ea quæ hodie à Gallis Vandoise vocatur, a Santonibus et Pictonibus Dard, quod sagittæ modo sese vibret."—(*De Aquatil.* p. 26.) Mr. Manley aptly quotes Drayton as having in his mind the "darting" Dace when he says—

"Oft swiftly as he swims, his silver belly shows;
But with such nimble flight, that ere ye can disclose
His shape, out of your sight like lightning he is shot."

Slightly altering a line in Keble's *Christian Year*, we may apply it especially to Dace as

"Living shafts that pierce" the stream.

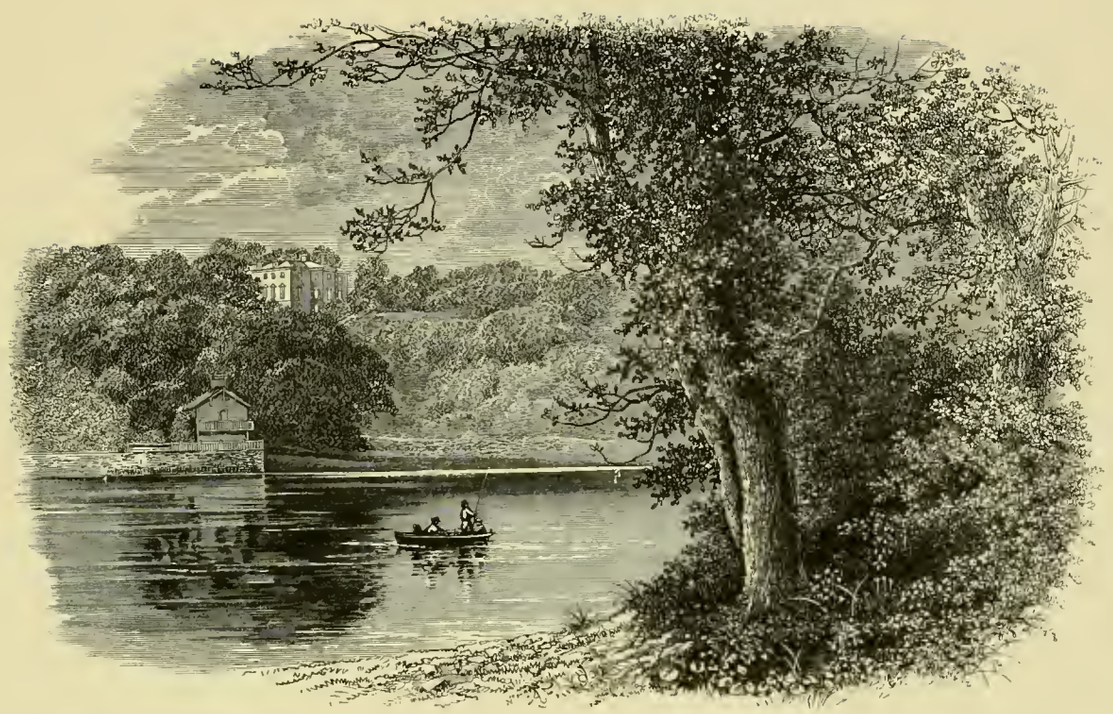
Vandoise or Vaudoise is at this day one of the French names of the Dace; it reminds one of the Vendace, or *Coregonus vandesius*, of Loch Maben in Dumfriesshire, one of the Salmonoids, but what the derivation of the word may be I know not, and M. Littré in his French Dictionary gives no explanation.

GRAINING.

DACE, like most other kinds of fish, are subject to variety, and ichthyologists now regard the Graining, first mentioned by Pennant, and described as a different species by Yarrell in the Linnæan Society's Transactions (vol. xvii., pl. i., p. 5), under the name of *Leuciscus lancastriensis*, as merely a variety of the Dace. Pennant says, "in the Mersey, near Warrington, and in the river Alt, which runs by Sephton, Lancashire, into the Mersey near Formby, a fish called the Graining is taken, which in some respects resembles the Dace, yet it is a distinct and perhaps new species."—(*Tour in Scotland and Voyage to the Hebrides*, pp. 11, 12.) The Earl of Derby, grandfather of the present Earl, supplied Yarrell with numbers of this fish, which that naturalist considered was entitled to rank as a distinct species. Mr. Thompson also obtained specimens of the Graining from the river Leam, near Leamington, and at Guy's Cliff, Warwickshire. The nose of the Graining is said to be more rounded than in the Dace, the scales rather larger, the radiating lines on the scales of the lateral line less numerous than those of the Dace; in colour the upper part of the head and body is pale drab, tinged with red, and separated from the lighter parts of the body below by a well-defined line. In the Dace the number of scales forming the lateral line is about fifty-two, as near as I can count from specimens before me; in the Graining Yarrell gives the number as forty-eight. There seems to be no recorded difference in the form of the throat teeth in the Dace and Graining. I have been unable to see any specimens of this fish, which is probably a mere variety of the Dace; the same perhaps may be said of the Dobule Roach *(Leuciscus dobula)* of Yarrell, which seems to be a young Dace.

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On the Dart.

Order IV.
PHYSOSTOMI.

Family
CYPRINIDÆ.

Rudd, or Red-eye.

(Leuciscus erythrophthalmus.)

Rootaug (das Rothauge), Red-eye, i.e. Erythrophthalmus Germanicus dictus,	Willughby, p. 249.
Cyprinus iride, pinnis omnibus caudaque rubris,	Artedi, Gen. Pisc. p. 3 No. 2.
Cyprinus erythrophthalmus,	Lin., Syst. Nat. i. p. 530; Donovan, Brit. Fish. ii. pl. 40.
Rud,	Pennant, Brit. Zool. iii. p. 318; Couch, Fish. Brit. Isl. iv. p. 49.
Roud (Norfolk), Finscale, Shallow, Red-eye, Rudd,	Yarrell, i. p. 412.
Leuciscus erythrophthalmus,	Fleming, Brit. An. p. 188; Cuvier; Thompson, Nat. Hist. Irel. iv. 138; Günther's Cat. vii. p. 231.
Azurine,	Yarrell, i. p. 416.
Scardinius erythrophthalmus,	Siebold, Süsserwasserfische p. 180.

THE Rudd is not uncommon in some of the rivers and ponds of this country; it is very like a Roach in general appearance, and often mistaken for one. There is one character, however, which at once reveals the difference between the Rudd and the Roach; in the

Roach, the origin of the dorsal fin is only slightly behind that of the ventral fin, while in the Rudd it is conspicuously behind it. The Rudd is generally distributed throughout the level counties of England; it occurs in the Thames and other waters near London, in Oxfordshire, Warwickshire, Shropshire, and other counties. In the Cam it is called the Shallow; but perhaps the Norfolk Broads are the waters where the handsomest and largest Rudd are produced. According to Thompson it is found from north to south of Ireland, chiefly in lakes and slow rivers; it is generally called a Roach throughout the island, where the true Roach does not occur.

The Rudd spawns in April and May, among the weeds of pools; its food consists of larvæ of insects, worms, small molluscs, and vegetable matter. In quality of flesh it is said to be preferable to the Roach. Where ponds are crowded these fish never attain to any size, but in suitable waters, as in the Norfolk Broads, they not unfrequently attain to a weight of two pounds. Mr. Manley recommends fishermen who want to make the special acquaintance of Rudd, to betake themselves to Slapton Ley and fly-fish for them on the sandy shallows in the summer months. "I am almost afraid," he adds, "to say how many score I have taken there in a few hours with a single-handed fly-rod and common red-palmer fly, but, remember, with a small piece of white kid glove the size of a gentle flying on the head of the hook. *Erythrophthalmus* at Slapton runs up to two pounds, is fairly sportive, but is such an easy prey to the seductive kid, that fishing for him loses part of its interest." A Rudd of one or two pounds is a very beautiful fish, with its bright red eyes and fins, and reddish gold body.

It is often thought that the Rudd is not a distinct species, but a hybrid between the Bream and the Roach. This seems to have been the common opinion in the time of Izaak Walton. "There is a kind of bastard small Roach," he says, "that breeds in ponds, with a very forked tail, and a very small size, which some say is bred by the Bream and right Roach, and some ponds are stored with these beyond belief; and knowing men that know their difference call them Ruds; they differ from the true Roach as much as a Herring from a Pilchard. And these bastard breed of Roach are now scattered in many rivers." The Rudd, however, fairly claims specific distinction, though hybrids between the Rudd and the Roach, as well as between the Rudd and the White Bream, have been observed in Germany and Holland.

The specific characters of the Rudd are thus given by Günther:—"Body elevated, its depth being generally more than one third of the total length (without caudal). Mouth terminal, narrow, very oblique; jaws even in front. There are three longitudinal series of scales between the lateral line and ventral fin. Origin of the dorsal conspicuously behind the root of the ventral. Belly behind the ventrals compressed into an edge, covered by the scales extending across it. Fins generally red, especially the lower. Pharyngeal teeth distinctly serrated."

The fin rays are

Dorsal 10—11
Pectoral 15.
Ventral 9—10.
Anal 13—15.

AZURINE.

THE Rudd, like fish generally, is subject to variety, and it would appear that the Azurine, or Blue Roach, first described by Yarrell under the name of *Leuciscus cæruleus* (Lin. Soc. Trans. vol. xvii. p. i. p. 8), is merely a variety of the Rudd. At the time Yarrell obtained specimens of the Graining from some of the Knowsley waters through the kindness of the Earl of Derby, he received also specimens of fish which he called the Azurine or Blue Roach. Through the kindness of Mr. T. J. Moore, of the Liverpool Museum, I have been able to examine a great number of these Azurines which came from the Knowsley pools; of course, having been for many years in spirits, they have lost their original blueness of colour. The position of the dorsal fin relative to the ventral, the narrow oblique mouth, and above all the serrated throat-teeth, which in no respect differ from those of the Rudd, all point to the conclusion that the Azurine is a variety of the Rudd or Red-eye. As to colour it is never safe to depend much on any peculiarity; we would do well to remember the admonition of the Roman Poet—"nimium ne crede colori." I am informed that these Azurine fish are not now found in the Knowsley ponds. The specimens in the Liverpool Museum are all of a small size, few being more than six or seven inches in length.

DOBULE.

THE Dobule Roach, a single specimen of which Yarrell took with the mouth of a White-bait net in the Thames below Woolwich, and which is regarded by Günther as a small Dace, is thus in its principal characteristics described by Yarrell:—"Body slender in proportion to its length; nose rather rounded, upper jaw longest; ventral fins arise just in advance of the line of the origin of the first ray of the dorsal fin; tail considerably forked; scales of moderate size, fifty forming the lateral line; the colour of the top of the head, nape, and back dusky blue, becoming brighter on the sides, and passing into silvery white on the belly; dorsal and caudal fins dusky brown; pectoral, ventral, and anal fins pale orange red; irides orange; cheeks and operculum silvery white."

The *Leuciscus dobula* of Agassiz, Cuvier and Valenciennes, is given by Günther as a synonym of the *Leuciscus cephalus*, or Chub.

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On the Thames.

Order IV.
PHYSOSTOMI.

Family
CYPRINIDÆ.

Tench.

(Tinca vulgaris.)

Tinca,	Auson., Id. x. 125; Gesner, De Aquatil. p. 984; Willughby, Hist. Pisc. p. 251.
Cyprinus mucosus totus nigrescens,	Artedi, Spec. Pisc. p. 5 No 7.
Cyprinus tinca,	Lin., Syst. Nat. i. p. 526; Donovan, Brit. Fish. v. pl. 113.
Tench,	Pennant, Brit. Zool. iii. p. 314; Couch, Fish. Brit. Isl. iv. p. 22.
Tinca vulgaris,	Cuv., Règne Anim.; Yarrell, i. p. 375; Siebold's Süsserwasserf. p. 106; Günther's Cat. vii. p. 264.

Characters of the Genus Tinca.—"Scales small, deeply imbedded in the thick skin; lateral line complete. Dorsal fin short, without spine, its origin being opposite the ventral fin; anal short; caudal sub-truncated. Mouth anterior; jaws with the lips moderately developed; a barbel at the angle of the mouth. Gill-rakers short, lanceolate; pseudobranchiæ rudimentary. Pharyngeal teeth 4 or 5—5, cuneiform, slightly hooked at the end. Europe."—Günther.

THIS handsome and valuable fish is mentioned once only in classical authors, namely, by Ausonius, in his Idyl on the Moselle. Ausonius appears to have shared what was probably the popular opinion of his day, which held the Tench in poor estimation as an

article of diet; he mentions this fish in company with White-fish and Shad in the lines—

"Quis non et virides vulgi solatia Tincas
Norit, et alburnos prædam puerilibus hamis,
Stridentesque focis obsonia plebis Alausas?" (Id. x. 125—127.)

"Who is not acquainted with the green Tench, the solace of the common people, and the Bleak, the spoil captured by boys' fish-hooks, and the Shad which hiss in the fire-pans, plebeian fish-fare?"

Tench thrive best in good-sized ponds, where there is plenty of water weeds of various kinds, as pond-weed, *Potamogeton*, *Myriophyllum*, &c.; the ponds must not be overstocked, otherwise the fish will not grow to any size, but keep small and thin. Tench are also found in some of our rivers; the Thames, in certain localities where the water is sluggish, being fairly well supplied with them. Deep clay-pits and broad shallow waters on muddy bottoms are productive. Yarrell states that some very extensive tracts of water a few miles north of Yarmouth, not far inland from a point called Winterton Ness, abound with Tench, which, when removed to stews, feed and thrive on a mixture of greaves and meal till fit for the table, and that the flesh is nutritious and of good flavour. As to the quality of the food opinions vary; some people regard the Tench as excellent, others will not touch it; for my own part, I think a well fed Tench of about two pounds in weight one of the best fresh-water fishes that we possess, and that it does not in the least require rich and savoury sauces to make it palatable.

The Tench spawns in June; the saying that this happens when "wheat is in flower" is as old as the time of Willughby, who writes "parit vere et æstate cum triticum floret." The female fish when about to deposit her spawn is attended by two or three males, who follow her about; at this time of the year they are very easily taken in a net. The eggs are small, and are, like those of the Carp, deposited on the weeds. The young fish grows rapidly. Couch states that in twelve months it may weigh from half a pound to a pound, and that an instance is known where a Tench, placed in a pond, in six years and a half attained to the weight of four pounds and a half, which would be considered in this country a fish of large size, though they have been taken of five or six pounds weight. The food of the Tench consists of worms and insect larvæ, but it also feeds extensively on vegetable matter. During the winter months it lies buried more or less deeply in the mud, and is dormant, like the Carp. From an examination of the stomachs of several Tench and Carp taken out of the mud in mid-winter, which, together with the whole intestinal tract, were quite empty, it appears that during this time these fish do not take food. It is well known that Tench are eminently tenacious of life, and are able to breathe with a very small supply of oxygen.

Izaak Walton calls the Tench the *physician of fishes*, especially for the Pike, which "being either sick or hurt is cured by the touch of the Tench;" he says that "the tyrant Pike will not be a wolf to his physician, but forbears to devour him though he be never so hungry." This is an old conceit, and is mentioned by Willughby and other authors; some modern writers appear to think there is some truth in the belief. I think we may safely dismiss the whole story as a myth; the Pike will certainly take a Tench just as well as he will another fish, when he is in the humour, and I have caught Pike occasionally when trolling with a small Tench as a bait; Mr. Masefield, of Ellerton, who has perhaps as much experience as any man living, tells me that Pike will eat a Tench as soon as any other fish, and that he has frequently taken Pike with this bait.

The male of the Tench is readily recognised from the female by the large cup-shaped ventral fins.

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GOLDEN TENCH.

The fin-ray formula is

Dorsal 10—11.
Pectoral 17.
Ventral 10.
Anal 9.

The scales of the Tench are very small, and the whole body is abundantly supplied with mucus.

GOLDEN TENCH.

THE Golden Tench is an extremely handsome fish; it is merely a variety of the *Tinca vulgaris*. It is said by Mr. F. Buckland to have been introduced in 1867, by Sir Stephen Lakeman, into this country; but we are not informed where from. In a letter I received last May (1878) from Mr. Higford Burr, of Aldermaston Park, Reading, that gentleman informs me that Mr. Buckland gave him two Gold Tench in September, 1862, and that these fortunately proved to be male and female. These two fish were placed in a pond by themselves and have bred. "I have now," says Mr. Burr (May 8th., 1878), "a great number; what we catch with rod and line in the summer I place in a small pond until cool weather sets in, when I am happy to distribute them to any gentleman who may apply for them." I do not know in what part of Germany or Austria this golden variety is found. Siebold. writing in 1863, says,—"This magnificent, black-spotted, orange-yellow or red variety of the Tench, which is known by the name of Gold Tench (*Gold-schleihe*), and which I have met with as a cultivated and an ornamental fish in Upper Silesia, has never yet been seen by me in the fish market here (Munich), nor was it noticed by Günther in the Neckar district; according to Heckel it occurs in the still waters of Salzach, which, however, I must doubt."—(*Die Süsswasserfische von Mitteleuropa*, p. 107.)

The specimen figured, which weighed one pound, was given to me by Mr. Masefield, who has set apart one of the ponds at Ellerton Hall for the breeding of these fish.

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COMMON BREAM.



Rydal Water.

Order IV.
PHYSOSTOMI.

Family
CYPRINIDÆ.

Common Bream.

(Abramis brama.)

Cyprinus latus sive Brama,	Gesner, De Aquatil. p. 316.
Cyprinus pinnis omnibus nigrescentibus,	Artedi, Spec. Pisc. p. 4 No. 2.
Bream,	Willughby, Hist. Pisc. p. 248; Pennant, Brit. Zool. iii. p. 317; Couch, Fish. Brit. Isl. iv. p. 36.
Bream, or *Carp-Bream,*	Yarrell, i. p. 382.
Cyprinus brama,	Lin., Syst. Nat. i. p. 531; Donovan, Brit. Fish. iv. pl. 93.
Abramis brama,	Fleming, Brit. An. p. 187; Günther's Cat. vii. p. 300.
Abramis Brama, Brachsen, Bley,	Siebold's Süsserwasserf. p. 121.

Characters of the Genus Abramis.—"Body much compressed, elevated or oblong; scales of moderate size; dorsal fin short, without spine, opposite to the space between ventrals and anals; anal fin long, many-rayed. Lower jaw generally shorter, and rarely longer than the upper; both jaws with simple lips, the lower labial fold being interrupted at the symphysis of the mandible; upper jaw protractile. Gill-rakers rather short; pseudobranchiæ. Pharyngeal teeth in one or two series, with a notch near the extremity. Belly behind the ventrals compressed into an edge, the scales not extending across it. Europe, north of the Alps, and adjoining parts of Asia; North America."—Günther.

ABRAMIS is the name of a fish mentioned by Oppian and Athenæus; the former speaks of these fish swimming in soals, and frequenting the rocks and shores of the sea, together with other marine species; and therefore the Bream, which is exclusively a fresh-

water fish, cannot be intended (*Halieut.* i. 244). Athenæus enumerates the *Abramis* among several other fishes found in the Nile. The *Abramis* of the Greeks has been referred to some species of Bream, therefore, without sufficient reason.

There are two undoubted British species of Bream, namely the Common or Carp-Bream (*Abramis brama*), and the White Bream, or Breamflat (*Abramis blicca*); the so-called Pomeranian Bream, the *Cyprinus Buggenhagii* of Bloch, being almost certainly a hybrid between the Common Bream and the Roach. The two first-named species, when young, are difficult to distinguish, for both are nearly white in colour; but older specimens of the Common or larger Bream become yellowish or yellowish brown, and are then readily to be distinguished from the silvery white Breamflat. An examination of the throat-teeth, however, will clear up any doubts as to the species, because those of the Common Bream are arranged in a single series of five on each bone, while the other species has a double row or series of five teeth in one and two in the other.

Bream are common in many of the lakes, ponds, rivers, and canals of this country. They thrive best in large pieces of water, and have been known to attain the weight of twelve or even fourteen pounds. Many parts of the Thames produce fine Bream, as at Walton, Hampton, Kingston, &c. In the Midland Counties, as in the Trent and the Ouse, Bream are abundant; Mr. Manley says that the Ouse is decidedly the best Bream river in England. The Norfolk Broads are also mentioned as producing Bream of a large size. In Shropshire I have seen great quantities of large Bream taken out of the Aqualate Mere, belonging to Sir Thos. F. Boughey, Bart.

Bream swim in shoals, and feed on worms and the larvæ of water insects, together with vegetable matter. Like some other of the *Cyprinidæ*, the males during the spawning season, which is in May, have white tubercles on the scales, and are rough to the touch. These disappear when the season of reproduction is over. The Thames fishermen bait their hooks with small red worms and brandlings; when hooked in deep water, according to Mr. Francis, the Bream "has a disagreeable nack of boring head down, and rubbing and chafing the line with its side and tail, so that the line often comes up for a foot above the hook covered with slime."

The flesh of the Bream is generally soft, insipid, and full of fine bones, and in little estimation for the table; but Mr. Francis assures us that when taken off a clean gravelly or sandy bottom in the winter time, "when the weed is out of them," they are by no means bad eating. This is quite probable, as the quality of the flesh of various fish depends to a considerable extent on the character of the water inhabited by them, and on the season of the year. In more ancient days the feeding and eating of Bream were more in fashion than at present. Chaucer says of his Frankeleyn—

> "Ful many a fat partrich had he in mewe,
> And many a brem, and many a luce in stewe."
> (*Prologue Cant. T.* 349.)

Juliana Berners says that "the Breme is a noble fysshe and a deynteous." Dr. Badham quotes a French proverb, "*Qui a brême peut bramer ses amis;*" "he who has Bream is able to ask friends to his table." Sir William Dugdale mentions that about the year 1419 a single Bream was valued at twenty pence, when the day's labour of a mason or master carpenter was less than sixpence, from which three-halfpence was deducted if his food was supplied to him. He also tells us that a pie containing four Bream was sent from Sutton, in Warwickshire, to the Earl of Warwick at Mydlam in the north country, at the cost of sixteen shillings; which amount included the wages of two men employed for three days in catching the fish, together with the spices and flour for making the pie.—(*Hist. Warw.*, p. 668.)

Bream are caught in enormous quantities in some places on the Continent. Nilsson tells us that when the fishing is being carried on in Sweden, in some of the parishes near the lakes it is forbidden to ring the church bells, that the noise may not alarm the fish. Ten to forty thousand pounds weight of Bream have been taken at a single haul of the net. Siebold (*Süsswasserf.*, p. 124) states that Bream, being eminently gregarious in their habits both at spawning and other times, are caught in immense number in the Spirdingsee and Bodensee below Constanz. "Even now," he says, "from time to time many hundred tons (*mehrere hundert Tonnen Brachsen*) of Bream are taken from the Spirdingsee at a single draught of the large winter nets."

Bream, like Carp and Tench, are tenacious of life, and will live for some time out of water. Though poor fare for the table, Bream are most useful fish in large ponds and lakes where there are many Pike, to which they contribute a constant supply of food.

The derivation of the word *Bream* is obscure; clearly it is only another form of the German *Brachsen*, French *Brème*, Old High German *Brahsema*, Dutch *Brassem*. The Low Latin form of the word is *Bresmia;* I suspect this is merely an altered form of the Greek *Αβραμις*, the derivation of which I have been unable to discover.

The head of the Bream is small; body very deep and compressed behind the ventral fin; tail much forked. The colour of large or moderate-sized specimens is yellow and brown on the back, pale below.

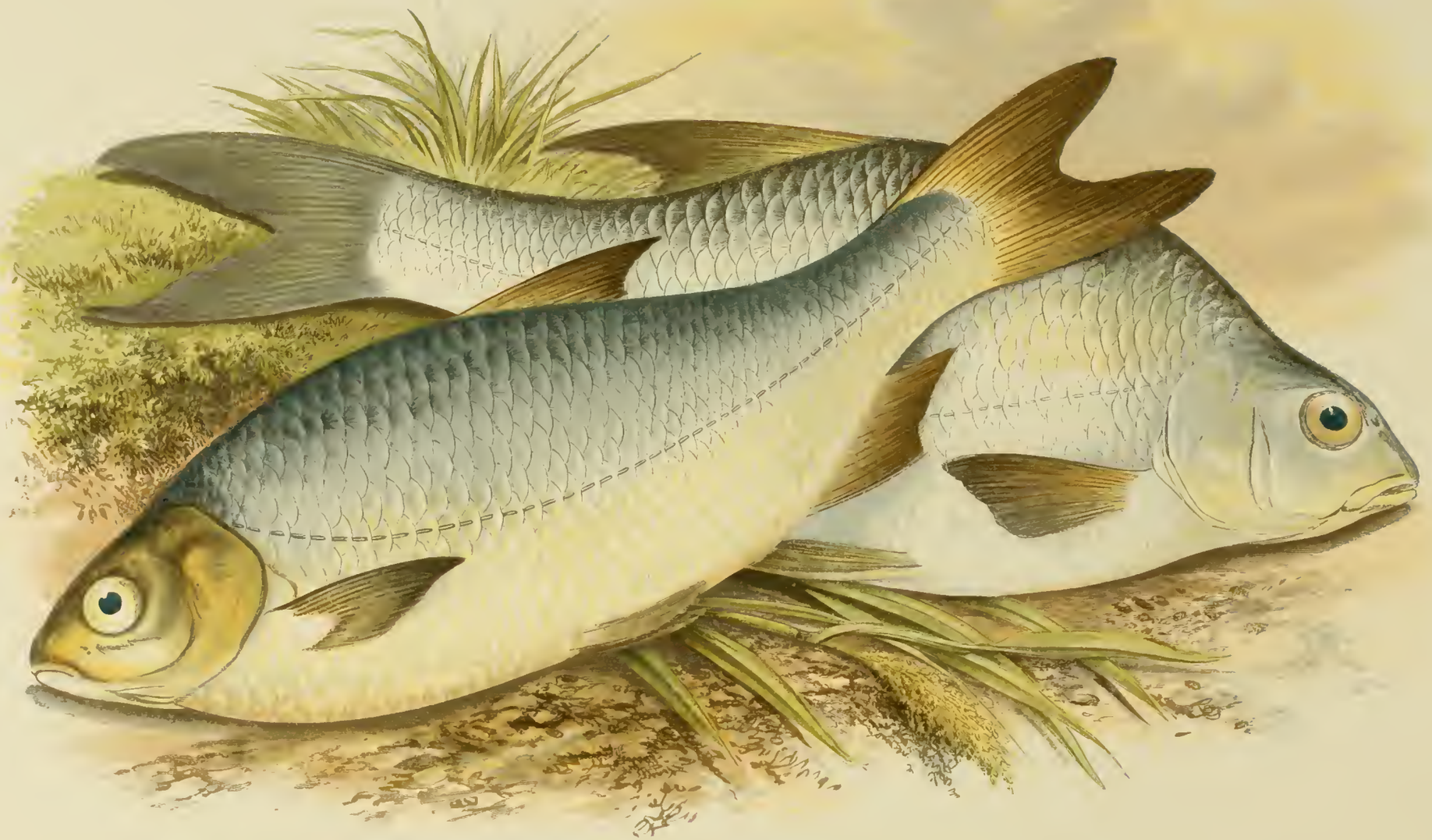
The fin rays are

Dorsal 12.
Anal 26—30.
Ventral 10.

The throat-teeth are 5—5.

The specimen figured was caught by a net in the Aqualate Mere last May (1878), and obligingly given to me with any other fish that I required by Sir Thomas F. Boughey, Bart.

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POMERANIAN BREAM

WHITE BREAM



On the Thames, near Eton.

Order IV.
PHYSOSTOMI.

Family
CYPRINIDÆ.

White Bream, or Breamflat.

(Abramis blicca.)

Blicca, Ballerus, Plestya,
Cyprinus admodum latus et tenuis,
Cyprinus björka,
Cyprinus blicca,
Abramis blicca,
White Bream,
Blicca björkna,

Gesner, De Aquatil. p. 24.
Artedi, Spec. Pisc. p. 12 No. 24.
Lin., Sys. Nat. p. 532.
Bloch, i. p. 65 pl. 10.
Cuv., R. A. ii. p. 274; Günther, Cat. vii. p. 306.
Yarrell, i. p. 387; Couch, Fish. Brit. Isl. iv. pl. 188.
Siebold's Süsserwasserf. p. 138.

THE White Bream is a much smaller species than the Common Bream, and is far less widely distributed over the country; it seldom exceeds one pound in weight, and is worthless as an article of diet; it is of bright silvery hue, and quite destitute of the yellow or golden lustre of its near relation. It is hardly possible to distinguish this species from the young individual of the Common Bream, because though the White Bream has never any yellowish tint, generally observable in large or middle-sized specimens of the other species, yet young Common Bream are very frequently white, and so similar in appearance

and form to the Breamflat, that discrimination is difficult until the throat-teeth are examined. The difference has already been pointed out in my notice of the Common Yellow Bream.

This species was first observed in this country in 1824, by the Rev. Revett Sheppard, who obtained specimens from the river Trent, near Newark; it was subsequently found by the Rev. L. Jenyns in the Cam, where it is called the Breamflat. It is much more common on the Continent, breeding in lakes and slow-running rivers; it is valued simply as affording food for Pike and other voracious fishes. The specific name, *blicca*, is from the Anglo-Saxon verb *blican*, "to shine," to which also the name Bleak *(Alburnus lucidus)*, another Cyprinoid, must be referred. The geographical distribution of the White Bream, according to Günther, is Europe, north of the Alps.

The fin rays are

Dorsal 10—11.
Pectoral 14.
Ventral 9—10.
Anal 22—27.

Hybrids between the White Bream and the Roach have been observed in Holland, Belgium, and Germany.

POMERANIAN BREAM.

THE fish to which Mr. Yarrell has given the name of the Pomeranian Bream, from the country in which it was first discovered by Bloch, viz. Swedish Pomerania, and which has been generally regarded as a species of *Abramis* distinct from the Common Yellow and White Breams, is in all probability a hybrid between the Common Yellow Bream *(Abramis brama)*, and the Roach (*Leuciscus rutilus*). Bloch, who has figured and described this fish in his work, *Naturgeschichte der Fische Deutschlands*, p. 95, gave to it the name of *Cyprinus Buggenhagii*, from the name of the gentleman, M. Buggenhagen, from whom he had received specimens. The late Mr. Yarrell received specimens of this fish from the waters at Dagenham Breach, Essex, in the year 1836. Mr. William Thompson, the Natural Historian of Ireland, noticed a specimen of this fish taken from the sluggish river Lagan near Belfast (*Nat. Hist. Ireland*, iv. p. 137). It has also been found in Cambridgeshire, in a tributary of the Colne near Hanworth, Middlesex, and in the Avon. I have had an opportunity of seeing a great number of these so-called Pomeranians which were caught in a net in different parts of the Aqualate Mere, Staffordshire, on the 7th. of May, 1878. Through the kindness of the proprietor, Sir Thomas F. Boughey, Bart., I was invited to be present when parts of this great sheet of water were netted, and allowed to take home with me such specimens as I desired. Siebold (*Süsserwasserfische*, p. 134), identifies this fish as the *Abramis Leuckartii* of Heckel, and states that it has been found in the Somme and Moselle by Selys-Longchamps, and in the Dniester by Nordmann; he certifies that it belongs not only to the basin of the Lower Rhine, but that it is also found in its middle course and its tributaries. Professor von Siebold is strongly of opinion that this fish is a hybrid between the Common Bream and some *Leuciscus*, although he has promoted it to the rank of a genus by giving it the name *Abramidopsis Leuckartii*. He says at the conclusion of his observations, "I will only

remark now that, although I have taken Heckel's *A. Leuckartii* to be a particular species, and have raised it to a genus, I have doubts whether this fish really deserves this special classification. The more specimens I have had to pass through my hands of *A. Leuckartii*, from different countries of Middle Europe, the more it appears to me that this Cyprinoid is nothing but a hybrid *(Bastard)* between an *Abramis* and a *Leucisus*."—(P. 137.)

The Pomeranian Bream has been admirably described by Dr. Günther as "a Roach-like modification of the Bream, or a Bream-like modification of the Roach." It differs from an *Abramis* in having a low back, less compressed body, a much less extended anal fin with rays not more than eighteen or nineteen, whereas in the Bream that fin has twenty-eight to thirty; it has not the long, scaleless, compressed ridge at the fore part of the back so characteristic of a true *Abramis;* the shape of the dorsal fin is different, it does not diminish sharply from the anterior extremity to the posterior basal portion; the belly behind the ventral fins is covered with angularly bent scales, in *Abramis* the scales do not extend across it; on the other hand this part of the belly is strongly Bream-like, being compressed into an edge; the throat-teeth in all the specimens I examined were in a single row of five; Siebold found six teeth on the left throat-bone twenty-four times in forty-five specimens, while in one specimen he found on the left throat-bone a double series, namely 1.6, and on the right a single series of 5; in another he found 1.5 teeth on the left and 5 on the right. Although the form and number of the throat-teeth in the *Cyprinidæ* afford a good guide in seeking to determine species, and although the number of teeth, whether in a single or double series, is generally more or less characteristic of a species, I have found that here, too, there is no rule without exceptions. On the whole the throat-teeth of this hybrid presents us with such a combination as one would expect in a fish intermediate between a Bream and a Roach. I have specimens of the pharyngeal teeth and throat bones of the Roach, Bream, and of the fish under consideration, and can confidently affirm that in this case also Günther's description of this fish, quoted just now, is most appropriate and correct. I may notice that when netting the large mere of Aqualate, only portions of which, on account of its great size, are available for this purpose, sometimes the net would bring to shore an immense quantity of Bream without any Roach; in such cases there were no Pomeranians; sometimes Roach and no Bream were caught, here again there was an absence of the Pomeranians; but in every case where the net secured both Bream and Roach, there was always found a certain number of these fish. The evidence, therefore, taken on the whole, satisfies me with the correctness of Professor von Siebold's opinion that the so-called Pomeranian Bream is merely a hybrid—but an exceedingly interesting one—between *Abramis* and *Leuciscus*, and that in the specimens I have been fortunate enough to examine that *Leuciscus* is the *L. rutilus*, or the Roach.

One of the names which the German fishermen give to this fish is *Leiter*, which means "a guide." Bloch states that the fishermen are greatly delighted when they take this fish in their nets, because they say they may then expect a successful haul. They have an idea that other Bream follow this fish. Siebold mentions this name when he says, "Very large specimens grown in the Frische Haff have been given to me at Tolkemit by the fishermen as so-called *Leiter* (guides)."

In a specimen from Aqualate Mere, measuring eleven inches from the snout to the bifurcation of the tail, the greatest breadth was four inches, the length of head two and a half; the origin of the ventral fin was about an inch in advance of that of the dorsal; the lateral line descending at first, then straight, then gradually and slightly ascending to a point nearer to the lower portion; irides pale straw; colour of pectoral, ventral, and caudal fins brownish, slightly tinged with red; scales large; whole body much more full and round than in the Bream, not compressed in the upper part of the back; belly compressed towards the anal fin and tail. Back at the upper part bluish black; sides and belly silvery white.

The fin-ray formula was

Dorsal 12.
Pectoral 16.
Ventral 9.
Anal 18.

The specimen from which the illustration was made was captured in the Aqualate Mere.

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MINNOW. LOACH BLEAK.



On the Derwent

Order IV.
PHYSOSTOMI.

Family
CYPRINIDÆ.

Bleak.

(*Alburnus lucidus.*)

Alburnus,	Auson., Id. x. 126.
Alburnus Ausonii,	Gesner, De Aquatil. p. 23; Willughby, p. 263.
Cyprinus quincuncialis, &c.,	Artedi, Spec. Pisc. p. 10 No. 19.
Cyprinus alburnus,	Lin., Sys. Nat. i. p. 531; Donovan, Brit. Fish. i. pl. 18.
Bleak,	Pennant, Brit. Zool. iii. p. 324; Couch, Fish. Brit. Isl. iv. pl. 195. Yarrell, i. p. 419.
Alburnus lucidus,	Günther's Cat. vii. p. 312; Siebold, Süsserwasserf. p. 154.

Characters of the Genus Alburnus.—"Body more or less elongate; scales of moderate size; lateral line running below the median line of the tail; dorsal fin short, without spine, opposite to the space between ventrals and anal; anal fin elongate, with more than thirteen rays. Lower jaw more or less conspicuously projecting beyond the upper. Lips thin, simple....Upper jaw protractile. Gill-rakers slender, lanceolate, closely set; pseudobranchiæ....Pharyngeal teeth in two series, hooked; belly behind the ventrals compressed into an edge....Europe; Western Asia."—Günther.

Izaak Walton has admirably described the little Bleak, which he aptly calls the Fresh-water Sprat, as "a fish that is ever in motion;" "and therefore," he adds, "called by some the river swallow; for just as you shall observe the swallow to be ever in motion,

making short and quick turns when he flies to catch flies in the air, by which he lives, so does the Bleak at the top of the water." How often have I in Oxford days, while waiting to take the accustomed oar in the University or College Boat, sat watching these silvery little fish, so abundant in the Thames and Cherwell, and admired their swallow-like movements! The Bleak is supposed to be referred to by Ausonius in his Idyll on the Moselle, in the line—

"Norit et Alburnos prædam peurilibus hamis."

"Who does not know the Bleak, the prey of boys' fish-hooks?"

The Bleak, which is found in many of our English rivers, as in the Thames, the Lea, the Trent, is said by Couch not to be a native of Ireland, that doubt exists as regards Scotland also, and that it is unknown in Cornwall and Devonshire. It is gregarious in its habits, is readily taken by a small artificial fly, or with a small bit of red worm, at a depth of ten to twenty inches. The spawning time takes place in May, at which time, as is the case with several other Cyprinoids, the head and gill-covers are rough to the touch. The little Bleak, says Siebold, as it swims near the surface of the water, often perceives when some rapacious Perch make a rush at it from underneath, when it jerks itself for a considerable space out of the water, and thus eludes the pursuit of its enemy.

From its surface swimming habits, as Siebold also remarks, it becomes very often the prey of birds, as the Sea Swallow (Tern), and as these fish generally are infested more or less with parasitic entozoa, the birds that swallow them become infested also.

We must never despise anything because it is small; everyone is familiar with those little, shining, brittle globules known as artificial pearls; the apparently insignificant, yet withal beautiful Bleak used to be the chief element in their production. A French bead-maker, by name Jaquin, found out how to make these artificial pearls, which, as Beckmann observes, "approach as near to nature as possible, without being too expensive." Jaquin noticed that when these fish, called *ables* or *ablettes* (a word evidently formed from *alburnus*), were washed, the water was filled with fine silver-coloured particles. This he allowed to settle, and then collected the sediment, which had the lustre of most beautiful pearls; this soft shining powder he called essence of pearl, or *essence d' orient*. At first he coated with it beads of gypsum or hardened paste, and, as Beckmann observes, "since everything new, particularly in France, is eagerly sought after, this invention was greatly admired and commended." It was found, however, that when exposed to the heat the pearly coat came off and adhered to the skin, which gave it a brightness far from desirable, so the ladies, for whose use it was chiefly intended, proposed to M. Jaquin that small hollow glass beads should be coated over in the inside with this essence of pearl. This he succeeded in doing; small glass tubes were dipped in, and the pearly pigment injected into hollow glass globules of various sizes and slightly different forms. The Bleak were caught in enormous numbers in the Seine, the Loire, the Saone, and the Rhine; four thousand fish producing about a pound weight of pearl essence, worth to the fisherman about twenty-five francs. The scale-deprived fish were sold at a cheap rate as food for the common people. Jaquin's date is uncertain, Reaumur mentions the year 1656. From France the invention found its way to this and other countries. I do not know whether the art of making these Bleak-scale pearls is practised at the present day or not. I may mention that Dr. Badham states that the manufacture of pearls from Bleak scales was at length superseded by that of Roman pearls, of soft unrivalled lustre; the Roman pearl-powder was obtained from the swim-bladder of some species of *Atherina* caught in immense numbers in the Tiber.

According to Izaak Walton, Bleak are "excellent meat;" Mr. Cholmondeley Pennell says that "a few dozen Bleak marinated form an excellent breakfast dish;" Mr. Francis considers them "very delicate eating when cooked in the way in which Sprats are commonly cooked;"

Mr. Manley holds that they "are neither worth the cooking nor eating, having a muddy flavour, or at the best being tasteless, while they are too large to eat like Whitebait, and too small to get a solid mouthful from."

From the Bleak's preference to feed in places where drains pour in their foul water, some have supposed arises the presence of a kind of tapeworm which infests the intestines of this fish, and that the agitated manner in which it often swims on the surface of the water is to be accounted for by the presence of its parasitic guest; hence the term "Mad Bleak," as applied to this fish when performing these uneasy gyrations. This may be so, but why are not other fish equally affected in a similar way? I have opened a great number of fish belonging to various families, and my experience is that they always contain parasitic entozoa, and very frequently *tæniæ* or tapeworm. A glance at Diesing's *Systema Helminthum*, vol. ii. p. 383 to 423, will show how extremely liable are all fish to various parasitic entozoa in different parts of their bodies. In the Roach Diesing enumerates as many as fourteen species as occurring; in the Bleak he mentions six, the species of tapeworm in the latter fish being the *Tænia torulosa* of Batsch.

The Bleak seldom attains to a length beyond seven inches; the colour when fresh is light greenish, or light brown with a slight tinge of blue; sides, cheeks, and belly brilliant silver; eye very large; the dorsal fin is situated far back; cleft of the mouth directed upwards.

The fin-ray formula is

Dorsal 10.
Pectoral 17.
Ventral 9—10.
Anal 18.

The specimen figured was taken from the Thames at Oxford.

Hybrids between the Bleak and Chub, and the Bleak and Rudd have been described.

Order IV.
PHYSOSTOMI.

Family
CYPRINIDÆ.

MINNOW.

(*Leuciscus phoxinus.*)

Phoxinus,	Belon, De Aquatil. p. 322.
Pisciculus varius ex Phoxinorum genere,	Gesner, p. 715.
A Pink or *Minim* or *Minnow*,	Willughby, Hist. Pisc. p. 268.
Cyprinus tridactylus varius oblongus teretiusculus,	Artedi, Spec. Pisc. p. 12 No. 23.
Cyprinus phoxinus,	Lin., Syst. Nat. p. 528; Donovan, Brit. Fish. iii. pl. 60.
Leuciscus phoxinus,	Fleming, Brit. An. p. 188; Yarrell, i. p. 423; Thompson, Nat. Hist. Ireland iv. p. 138; Günther's Cat. vii. p. 237.
Phoxinus laevis,	Siebold's Süsserwasserf. p. 222.
Minnow, *Minim* or *Pink*,	Yarrell, i. p. 423; Couch, Fish. Brit. Isl. iv. 64.

IT is not at all certain that the fish of which Aristotle speaks under the name of Φοξινος is the Minnow of our rivers and streams, although this term has been applied to this little fish ever since the time of Belon (born about A.D. 1518). The Greek word signifies

"tapering to a point," which may have reference to the hinder part of the body of a Minnow, which is somewhat elongated and slender. Aristotle speaks of the *phoxinus* as having ova inside it as soon as it is born, and as depositing its ova in a stream, and adds that the males devour great numbers of them, while other ova perish in the water.

The Minnow, as its name declares, from *minimus*, "very little," is the smallest of the British *Cyprinidæ*, seldom exceeding three inches and a half; it is found in many rivers and streams of this country. It is believed not to have been originally a native of the Irish rivers, and to be still a very local fish in that country. In Scotland it is said to be common.

The Minnow is a very prolific breeder; the abdomen of the females in June being greatly distended with ova; the spawning season lasts only a short time, generally not more than two or three days, and the eggs soon become young fish. Yarrell says he has taken them three-quarters of an inch long by the first week in August. The young fellows are quite transparent with the exception of the large black eyes; it is said that in this state the larvæ of the May-fly (*Ephemera vulgata*) are among their greatest enemies; the diminutive fry seem to be aware that they owe their safety to concealment, for when exposed they immediately bury themselves in the gravel. In an aquarium, or in a small clear pond they become tame. It is quite amusing to observe a whole host of hungry Minnows chasing a bit of bread about. These little fish are free biters and are readily caught with a small hook and a piece of a worm; as spinning-bait for Trout, Perch, and small Pike, the Minnow cannot be surpassed; he is moreover a very handsome little fish. "Lay one when in full season," Mr. Manley enthusiastically says, "on the palm of your hand, examine and admire him. Mark his shape —a miniature Salmon in symmetrical configuration. Mark his beautiful colouring—every shade of olive, white, pale brown, silver, pink, and rosy harmoniously blended, and producing that beautiful mottled appearance which reminds one of the Mackerel and of the *Salmo fontinalis*, the lovely American Brook-trout, which I hope before long will be naturalized in many of our waters." According to Mr. Manley, small Minnows are an excellent substitute for real Whitebait.

The Minnow is said occasionally to eat its own dead, a feature which can hardly recommend itself to our admiration. A writer in the fifth volume of Mr. Loudon's *Magazine of Natural History* relates that, crossing a brook, he saw from the foot-bridge something at the bottom of the water which had the appearance of a flower. "Observing it attentively," he adds, "I found that it consisted of a circular assemblage of Minnows; their heads all met in a centre, and their tails diverging at equal distances, and being elevated above their heads, gave them the appearance of a flower half-blown. One was longer than the rest, and as often as a straggler came in sight he quitted his place to pursue him; and having driven him away, he returned to it again, no other Minnow offering to take it in his absence. This I saw him do several times. The object that had attracted them all was a dead Minnow, which they seemed to be devouring." This ring or flower-like arrangement of their bodies round some attractive morsel as a nucleus I have repeatedly witnessed myself.

The characters of this species are thus given by Dr. Günther:—"Dorsal fin opposite to the space between ventrals and anal. Mouth anterior; upper jaw slightly overlapping the lower; body cylindrical. A blackish spot at the base of the caudal (which is forked); a more or less distinct series of blackish spots along the side of the body, the spots sometimes confluent into a band. Pharyngeal teeth uncinate, 5 or 4.2, 2.4 or 5. Gill-rakers very short and few in number; pseudobranchiæ. Europe."

The fin rays are

Dorsal 9.
Pectoral 16.
Ventral 8—9.
Anal 9—10.

Order IV.
PHYSOSTOMI.

Family
CYPRINIDÆ.

LOACH.

(*Nemachilus barbatulus.*)

Cobitis fluviatilis barbatula,	Gesner, De Aquatil, p. 404.
The Loche; Germanis, *Grundel,*	Willughby, Hist. Pisc. p. 265.
Cobitis tota glabra maculosa, corpore subtereti,	Artedi, Spec. Pisc. p. 2 No. 1.
Cobitis barbatula,	Lin., Sys. Nat. i. p. 499; Yarrell, i. p. 427; Donovan, Brit. Fish. i. pl. 22; Siebold, Süsserwasserf. p. 337.
The Loach, Loche or *Beardie,*	Yarrell, i. p. 427; Couch's Fish. Brit. Isl. iv. pl. 199.
Nemachilus barbatulus,	Günther's Cat. vii. p. 354.

Characters of the Genus Nemachilus.—"No erectile suborbital spine. Six barbels, none at the mandible. Dorsal fin opposite to the ventrals. Air-bladder enclosed in a bony capsule."—Günther.

THE Loach, Loche, Stone-Loach, Beardie, or Groundling is a well-known little fish, common in most of our brooks and streams; but on account of its habit of hiding with its body more or less concealed from view under stones or under submerged bodies it is not often seen. It is found in various streams throughout Europe, with the exception of Denmark and Scandinavia.

The Loach delights in clear running rivulets, which it prefers to broad rivers; during the day-time it keeps chiefly to the bottom, and thus affords great pleasure to country lads, who have to exercise a little ingenuity and skill in catching the slimy creatures, which dart rapidly away when disturbed from their places of concealment. From the possession of the six barbules which fringe the upper lip, four in front and one at each angle, it may be inferred that the Loach principally obtains its food from the bottom of the water; these barbules are most beautifully and abundantly supplied with nerves, and no doubt serve as instruments of touch, whereby the little fish is enabled to discover the nature of its food. The small size of the Loach renders it an excellent subject for dissection under a binocular microscope, and an examination of the nerves with which these cirri or barbules are supplied will repay anyone who cares to study the matter.

The Loach spawns in March and April; the number of eggs, which are very small, must be very great, for at this period the females have their abdomens very much distended with the ova. The fecundity of this fish seems to be alluded to by Shakespeare:—"Your chamber lie breeds fleas like a Loach;" that is, I suppose, is as prolific of fleas as a Loach is of spawn.

This fish has been, and still is by some persons, accounted an excellent food. "In some parts of Europe," says Yarrell, "these little fishes are in such high estimation for their exquisite delicacy and flavour, that they are often transported with considerable trouble from the rivers they naturally inhabit to waters contiguous to the estates of the wealthy." Siebold also tells us that owing to the savoury flesh of this fish, it is in universal estimation, and frequently brought to market.

The Loach feeds on the larvæ of aquatic insects, and such small worms as it can meet with; it will not unfrequently bite at a baited hook. Their small size, however, is no

inducement for the fisherman, unless he wants them as bait for Trout, small Pike, or Perch, and even for this purpose they are not to be recommended, for the flesh is delicate.

The Loach, and the Spined Loach, the next species to be described, are the only two British fresh-water fishes which have their air-bladder enclosed in a bony capsule, a peculiarity, however, which is common to all the group of the *Cobitidinæ*. This bony capsule, in the Loach, consists of two globular cases connected together by a short transverse channel. It is situated near the second vertebræ. By means of a fine needle these osseous capsules may be broken, and the air-bladder disengaged. This organ is figured in Yarrell, who, however, mistook its nature, he regarding "these circular bones as analogous to the scapulæ."

The Loach seldom exceeds the length of five inches, and generally does not attain to that size; the head is somewhat depressed or flattened; eyes small; snout produced; body round at first, then flattened; origin of the dorsal fin about half way between the end of the snout and the root of the tail. Colour prettily marbled or mottled with dark brown; tail and dorsal fin with brownish-black spots in cross bands; ground colour of head, body, and sides yellowish white.

The fin rays are

Dorsal 9—10.
Pectoral 12.
Ventral 7.
Anal 6.

The generic name of *Nemachilus* (*i.e.* "thread-lipped") contains such species of the group as do not possess an erectile suborbital spine, like the Spined Loach. "The Common Pond-Loach," (*Cobitis fossilis*), to which Dr. Badham and Mr. Manley refer, whose favourite pastime is to roll and wallow in the mire of his pond, the *Schlammpitzger* and *Moorgrundel* of the Germans, found in Central and Eastern Europe, is not known to occur in this country. The origin of our English word Loach, with which the French *Loche* and the Spanish *Loja* are identical, is obscure. The German names of this fish are *Bartgrundel* and *Schmerle*.

Order IV.
PHYSOSTOMI.

Family
CYPRINIDÆ.

SPINED LOACH, OR GROUNDLING.

(*Cobitis tænia.*)

Cobitis aculeata,	GESNER, De Aquatil. p. 404.
Cobitis barbatula aculeata,	WILLUGHBY, p. 265.
Cobitis aculeo bifurco infra utrumque oculum,	ARTEDI, Spec. Pisc. p. 3 No. 2.
Cobitis tænia,	LIN., Sys. Nat. i. p. 409; BLOCH; LACÉPÈDE; CUV. AND VAL.; SIEBOLD, Süsserwasserf. p. 338; GÜNTHER'S Cat. vii. p. 362.
Botia tænia,	YARRELL, i. p. 432; COUCH, Fish. Brit. Isl. iv. p. 72.

Characters of the Genus COBITIS.—"Body more or less compressed, elongate; back not arched. A small, erectile, bifid suborbital spine below the eye. Six barbels, only on the upper jaw. Dorsal fin inserted opposite to the ventrals; caudal rounded or truncate. Air-bladder enclosed in a bony capsule. Europe; East-Indian Continent."—GÜNTHER.

THE Spined Loach is a very small fish, seldom exceeding three inches in length, and but little known in this country. It is said to occur in the Trent near Nottingham, in the clear streams of Wiltshire, Warwickshire, and Cambridgeshire. Its habits are probably similar to those of the Stone-Loach. According to Siebold, the Spined Loach—the *Dorngrundel* or *Steinbisser* of the Germans—is the smallest of the species known on the Continent, never exceeding four inches at most. "Its propagation is similar to that of the *Bissgurre* (*Cobitis fossilis*), and it lives in concealment like it, only with this difference, that it does not increase to the same extent, and chooses for its abode brooks and streams as well as ponds."

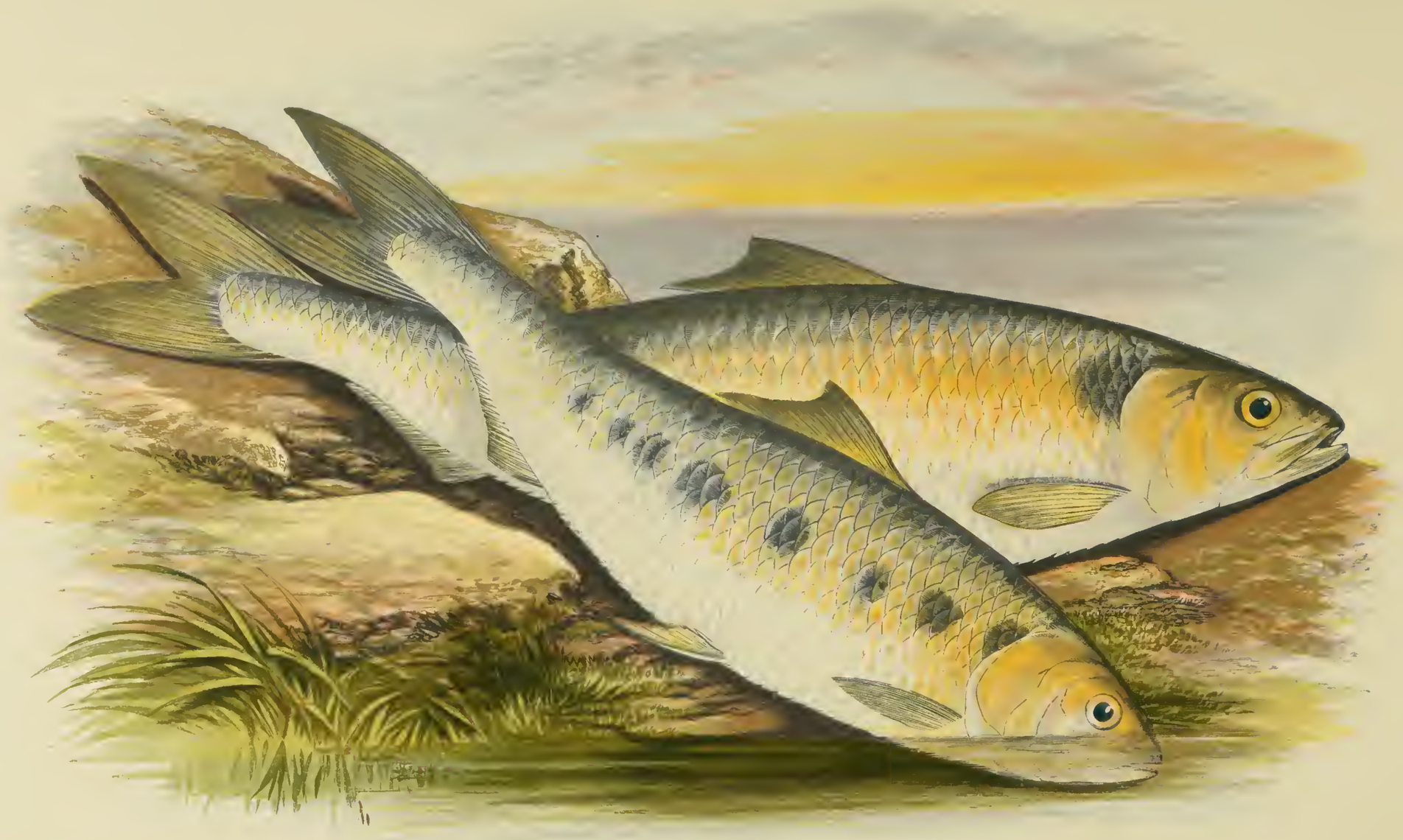
The spawning time is during the warm months of spring.

The spine is forked and moveable, but what its functions may be I know not; I have been unable to get hold of a specimen of this fish. According to Yarrell, the form of the body is still more elongated, slender, and compressed than that of the Loach; the nose more pointed; the mouth and eyes smaller in proportion; the pectoral fin longer and narrower; all the fins occupy the same relative situation. The colours are similar, both of the body and fins, but a row of dark brown spots ranged along the side is the most conspicuous.

The fin-ray formula is said to be

Dorsal 8 (but 10 according to Günther).
Pectoral 9.
Ventral 6—7.
Anal 7.

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ALLIS SHAD

TWAITE SHAD



On the Wye.

Order IV.
PHYSOSTOMI.

Family
CLUPEIDÆ.

Allis Shad.

(*Clupea alosa.*)

Alausa,	Auson., Id. x. l. 127.
Clupea alosa,	Cuv., R. A. ii. p. 319; Jenyns' Man. p. 438; Günther's Cat. vii. p. 433.
Alosa communis,	Yarrell, ii. p. 213; Parnell, Mem. Werner. Soc. vii. p. 330.
Alosa vulgaris,	Siebold, Süsserwasserf. p. 328.
Allis,	Pennant's Brit. Zool. iii. p. 307.
Allis Shad,	Couch's Fish. Brit. Isl. iv. p. 117.

Characters of the Genus Clupea.—"Body compressed, with the abdominal serrature extending forwards into the thoracic region. Scales of moderate or large, rarely of small size. Upper jaw not projecting beyond the lower. Cleft of the mouth of moderate width; teeth, if present, rudimentary and deciduous. Anal fin of moderate extent, with less than thirty rays; dorsal fin opposite to the ventrals; caudal forked. Inhabitants of the coasts of every part of the globe; many species entering fresh water."—Günther.

TWO British species of Shad are known to occur in the waters of our coasts and in some of our rivers, namely, the Allis Shad and the Twaite Shad, and so similar are they in general form and appearance, that they have, both in ancient and modern times been frequently confounded. There seems to be no doubt that under the name of *θρισσα, τριχια,* and

other similar forms, certain species of the *Clupeidæ* were known to the ancient Greeks, but I do not agree with those authors who refer the θρισσα of Aristotle, Ælian, Oppian, Athenæus, and others, without the slightest hesitation exclusively to either of our Shads, although it is probable these fish were known both to the ancient Greeks and Romans. The Greek word θρισσα is derived from θριξ, τριχος, "a hair," and probably has reference to the hair-like bones which are contained in the flesh of most of the Herring family; and consequently the Shad may be, with others of the *Clupeidæ*, included under the Greek name. Be this as it may, ancient authority has referred the θισσα of the Greeks, and the *alausa* which Ausonius mentions, to a Shad. From this latter word the Germans have formed their *alsen*, *elson;* whence also our English word Allis as applied to the species under our consideration. Dr. Badham says that the Shad "forms one of an elaborately finished group of mosaic fish in a house at Pompeii." Here, then, there is evidence of these fish having been known to the Romans. Ausonius, in the line—

"Stridentesque focis opsonia plebis alausas,"

speaks of the Shad as pauper's fare; whether this was the general opinion amongst his countrymen one cannot say.

The Allis Shad ascends some of our rivers in the months of April and May for the purpose of spawning. It is a local fish, being of rare occurrence in the Thames, but in some seasons abounding in certain parts of the Severn and the Wye. It is said to be frequently taken on the north-eastern coasts of England, as at Berwick; also at the mouth of the Tweed in autumn. According to Parnell, it is of rare occurrence in the Firth of Forth; the same writer says that "it is frequently reported that Herrings of a large size, measuring from twenty to twenty-four inches in length, are occasionally taken off the Dunbar and Berwickshire coasts, and which the fishermen name the Queen of the Herrings, but that it is probable the fish they allude to is the Allis Shad."—(*Fishes of the Firth of Forth*, p. 332 in vol. vii. *Mem. Wern. Nat. Hist. Soc.*) Mr. Buckland tells us that he once received a telegram from a gentleman saying that a monster Herring had been taken in the fresh-water part of the Tay, weighing five pounds and a half. This of course proved to be the Allis Shad. The Shad used at one time to ascend the Severn as far as Shrewsbury, but I am told it is never now found higher up than Worcester. I may mention that the Flounders used to ascend the Severn as far as Shrewsbury several years ago, but that they have long ceased to do so. The Severn navigation weirs prevent the ascent of Shad and Flounders beyond certain parts of the river; excepting in very high tides Shad seldom come up as far as Diglas, which is about one mile below Worcester. The spawning of both species of Shad has often been observed in the gravelly pools near Powick, on the Teme, near Worcester. The Shad spawns in May and early June, and chooses shallow rocky places. The fishermen near Worcester call the Shad the "May-fish," as do the Germans. Couch says that the "proceeding is conducted at night, at which time the fish may be heard to make a rattling noise, as if beating the water with their tails." After spawning the Shad soon return to the sea, where they are occasionally caught with a line by those who are *whiffing* for Pollacks, the bait being either the Mud Lamprey or a slice of Mackerel; they have also been caught with a trammel in deep water.

When in the rivers, where they remain on an average about two months, they are taken in nets of two hundred yards long, the mesh being one of three inches. Couch states that seventy to eighty dozen have been caught in a night, the time chosen for taking this fish, which has the character of being shy and timid.

The flesh, as an article of diet, is fair, and though far inferior, in my opinion, to that of a Herring, it is nevertheless good food. I believe that the London markets and the markets

of the large towns are supplied with Shad to a considerable extent from Holland, a country famous for its fisheries.

I have already remarked that the two species of Shad are similar, and that it is not easy to distinguish the one from the other on mere external inspection; there is, however, a character which reveals itself on an examination of the gills, and which is a decisive test as to the species, whether it be the Allis or the Twaite (*alosa* or *finta*). In *alosa* the gill-rakers are fine and long, in number from sixty to eighty, on the horizontal part of the outer branchial arch; in *finta* these gill-rakers are strong and bony, in number varying from twenty to twenty-seven.

The Allis Shad, or "King of the Herrings," as it is sometimes called, grows to the length of two feet or more, with a weight of about three pounds, and this is not uncommon; but fish of five pounds' weight and more have been noticed. The specimen I had for examination measured twenty inches in length, and about six inches in its greatest breadth above the dorsal fin; its weight was three pounds and a half.

The height of the body compared with the length is as one to four and a half; ventral fins behind the origin of the dorsal; tail deeply bifurcated; there is a large blackish blotch just behind the upper portion of the gill-cover, which is sometimes followed by a series of smaller black patches. As a rule, the next species (*Clupea finta*) is more generally marked with these smaller patches.

The fin-ray formula is

Dorsal 19.
Pectoral 15.
Ventral 9.
Anal 20—24.

Order IV.
PHYSOSTOMI.

Family
CLUPEIDÆ.

TWAITE SHAD.

(*Clupea finta.*)

Twaite Shad,	YARRELL, ii. p. 208; COUCH, Fish. Brit. Isl. iv. p. 123.
Clupea apice maxillæ superioris bifido, maculis nigris utrinque,	ARTEDI, Spec. Pisc. p. 15 No. 2.
Clupea fallax,	LACÉPÈDE, v. p. 452.
Alosa finta,	YARRELL, ii. p. 208; SIEBOLD, Süsserwasserf. p. 332; CUV., Règne Anim.
Clupea finta,	JENYNS' Man. p. 437; GÜNTHER, Cat. vii. p. 435.

THIS species is both in general appearance and habits very similar to the Allis Shad, with which it has often been confounded; the distinction, first pointed out by Troschel, lies, as noticed in what has been said when speaking of the Allis Shad, in the shape and number of the gill-rakers. The Twaite Shad never attains to the size of the other species, nor is it considered as good a fish for the table. It enters some of our rivers about May for

the purpose of spawning; on which account this fish, as well as the Allis Shad, is on the Continent sometimes called "May-fish;" it remains in our rivers for two or three months, and then descends to the sea. These fish were formerly very abundant in the Thames. Yarrell says that Twaite Shads appear during the months of May, June, and July, in great numbers in the Thames from the first point of land below Greenwich, opposite to the Isle of Dogs, to the distance of a mile below, and that many are taken, but that they bring a small price to the fishermen, being in little repute as food, "their muscles being dry and full of bones." The present condition of the Thames, I suspect, prevents this periodic migration of the Twaite Shad.

Some writers have supposed that the Twaite can be distinguished from the Allis by its possessing teeth in both jaws, and by having a row of dusky spots along each side of the body, the Allis having one spot only near the head; but Dr. Günther has shown that it is impossible to form "a systematic arrangement of a group of animals based exclusively on differences in an organ which has become rudimentary, or where it is subject to even individual variations." The teeth in the members of the genus *Clupea* are a very unsafe guide whereby to lead to real characteristic distinctions; "they are more or less completely lost in a number of individuals either by accident or by age; those on the tongue, if present, are a more constant part of the dentition; yet there are numerous species in which the lingual teeth are few in number, and as readily lost as those in the jaws. Nearly the same may be said with regard to the teeth on the palate; and innumerable instances may be met with in which it is impossible to say whether a certain bone has been provided with teeth or not." In the two Shads there is no real difference in the dentition; neither species has teeth on the palate, the vomer, the tongue, or on the under jaw, while the teeth on the intermaxillary and the maxillary (upper jaw) are deciduous. Both species are occasionally marked with a series of blackish patches along the sides of the body; in the discrimination, therefore, of these two Shads, recourse must be had to the examination of the gill-rakers as the only safe guide.

What the derivation of the terms Shad, and Thwaite or Twaite may be, I know not; the specific name of *finta* is the Italian *finta*, "simulation." The French name of this Shad is *La Feinte*, and doubtless, as Littrè says, was given to this species because it resembles the Allis Shad; "*Ainsi dit parce que c'est une alose feinte.*" The Germans generally call the Allis Shad *Die Maifisch*, or *Mutterhäring*, and the Twaite Shad *Die Finte*.

There is no real difference in the fin rays of this species from the other Shad.

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PIKE.



On the Doon

Order IV.
PHYSOSTOMI.

Family
ESOCIDÆ.

Pike.

(Esox lucius.)

Lucius,	Ausonius, Id. x. 122; Gesner, De Aquat. p. 500; Willughby, Hist. Pisc. p. 236.
Esox rostra plagioplateo,	Artedi, Spec. Pisc. p. 26 No. 1.
Esox lucius,	Lin., Sys. Nat. i. p. 516; Donov., Brit. Fish. v. pl. 109; Jenyns' Man. p. 417; Günther's Cat. vi. p. 226; Siebold, Süsserwasserf. p. 325.
Pike or *Pickerell*,	Willughby, p. 236; Pennant, Brit. Zool. iii. p. 424, ed. 1812; Yarrell, i. p. 434; Couch, Fish. Brit. Isl. iv. p. 150.

Characters of the Genus Esox.—"Body elongate, covered with small cycloid scales, many with a muciferous channel; lateral line distinct; eye of moderate size. Snout elongate, broad, depressed, with the lower jaw the longer; cleft of the mouth very wide. Teeth of the mandible in a single series, unequal in size; some large; intermaxillary, vomer, palatine, and hyoid bones with bands of cardiform teeth; maxillary toothless. Dorsal fin opposite the anal. Caudal forked."—Günther.

THE Pike was probably unknown to the ancient Greeks; at any rate there is no mention of this fish in any Greek author; among the Latins, Ausonius is the only writer who clearly alludes to it in the following lines:—

Hic etiam Latio risus prænomine, cultor
Stagnorum querulis vis infestissima ranis
Lucius, obscuras ulva cænoque lacunas
Obsidet: hic nullos mensarum lectus ad usus,
Fervet fumosis olido nidore propinis. (120—124.)

"Here also, under a name ridiculous in Latium,* an inhabitant of the ponds, a most hostile power to the croaking frogs, the Pike (Lucius) haunts the pools dark with weed and mud; this fish, chosen for no uses of the table, steams with a bad smell in the smoking cook shops."

Dr. Badham renders the passage in verse, less literally,—

"The wary luce midst wrack and rushes hid,
The scourge and terror of the scaly brood,
Unknown at friendship's hospitable board,
Smokes 'midst the smoky tavern's coarsest food."

The Pike is supposed by some to be an introduced fish into this country, and although it is now very common in the rivers, ponds, and lakes of England, Wales, Scotland, and Ireland, there is evidence to show that at one time it was considered rare. "In the latter part of the thirteenth century," says Yarrell, "Edward the First, who condescended to regulate the prices of the different sorts of fish then brought to market, that his subjects might not be left to the mercy of the vendors, fixed the value of Pike higher than that of fresh Salmon, and more than ten times greater than that of the best Turbot or Cod." Pikes are mentioned in an act of the sixth year of the reign of Richard the Second, 1382, which relates to the forestalling of fish, (see Pennant, *Brit. Zool.* iii. p. 425, ed. 1812); and they were served at the great feast given by Archbishop Neville in the year 1466. Pike are said to have been so rare in the reign of Henry the Eighth that a large one sold for double the price of a lamb in February, and a Pickerel (or small Pike) for more than a fat capon.

According to Couch the Pike is known in almost every part of England except Cornwall. It is found in the fresh waters of the temperate parts of Europe, Asia, and North America; in American specimens, according to Günther, there are generally seventeen anal rays, and only exceptionally nineteen; whilst the European examples have nineteen, a less number being of very rare occurrence.

The usual haunts of the Pike in the deep pools of slow-flowing rivers, and weedy ponds, did not escape the notice of Ausonius as quoted in the lines above. "In such places, shrouded from observation in his solitary retreat, he follows with his eye the motions of the shoals of fish that wander heedlessly along; he marks the water-rat swimming to his burrow, the ducklings paddling among the water-weeds, the dabchick and the moorhen leisurely swimming on the surface; he selects his victim, and like the tiger, springing from the jungle, he rushes forth, seldom indeed missing his aim: there is a sudden rush, circle after circle forms on the surface of the water, and all is still again in an instant."—(*British Fish and Fisheries.*)

I need not give many instances of the well-known voracity of the Pike; such as may be seen in the works of some of the old writers, as Gesner, Rondeletius, Walton, and others. But the following quite modern story (for it happened in June 1856) is well authenticated, and is given by Mr. Cholmondeley Pennell in his excellent handbook *The Angler Naturalist;* it is headed "Particulars of an Encounter with a Fish in the month of June, 1856." The account is given by the boy's father, Mr. George Longhurst, of Sunning Hill. "One of my sons, aged fifteen, went with three other boys to bathe in Inglemere Pond, near Ascot Racecourse; he walked

* Lucius was a favourite prænomen among the Romans, as is attested by the frequent occurrence of the letter L. at the beginning of inscriptions. King Lucius Tarquinius Priscus appears to have been the first important personage who bore the name, which is evidently derived from *lux*, "light." Ausonius means to say that it is ridiculous for so worthless a fish as the Pike to be called after a name which kings and nobles have borne.

gently into the water to about the depth of four feet, when he spread out his hands to attempt to swim; instantly a large fish came up and took his hand into his mouth as far up as the wrist, but finding he could not swallow it, relinquished his hold, and the boy turning round, prepared for a hasty retreat out of the pond; his companions who saw it, also scrambled out of the pond as fast as possible. My son had scarcely turned himself round when the fish came up behind him and immediately seized his other hand, crosswise, inflicting some very deep wounds on the back of it; the boy raised his first-bitten and still bleeding arm, and struck the monster a hard blow on the head, when the fish disappeared. The other boys assisted him to dress, bound up his hand with their handkerchiefs, and brought him home. We took him down to Mr. Brown, Surgeon, who dressed seven wounds in one hand; and so great was the pain the next day, that the lad fainted twice; the little finger was bitten through the nail, and it was more than six weeks before it was well. The nail came off and the scar remains to this day." And what became of the Pike? Retribution quickly followed this would-be boy-devourer! "A few days after this occurrence, one of the woodmen was walking by the side of the pond, when he saw something white floating. A man, who was passing on horseback, rode in, and found it to be a large Pike in a dying state; he twisted his whip round it and brought it to shore. Myself and my son were immediately sent for to look at it, when the boy at once recognised his antagonist. The fish appeared to have been a long time in the agonies of death; and the body was very lean and curved like a bow. It measured forty-one inches, and died the next day, and was, I believe, taken to the castle at Windsor."

There is an old myth that the Pike will spare the Tench, his piscine "physician." The following story, communicated by Dr. Genzik to Mr. C. Pennell, will show that he does not hesitate to attack a human physician, or at any rate a medical student. "In 1829 I was bathing in the swimming school at Vienna with some fellow-students, when one of them—afterwards Dr. Gouge, who died a celebrated physician some years ago—suddenly screamed out and sank. We all plunged in immediately to his rescue, and succeeded in bringing him to the surface, and finally in getting him up on to the boarding of the bath, when a Pike was found sticking fast to his right heel, which would not loose its hold, but was killed and eaten by us all in company the same evening. It weighed thirty-two pounds. Gouge suffered for months from the bite."

Referring back to the Pike sparing the Tench, because the former fish is grateful for supposed services rendered by the latter in rubbing itself against the Pike's wounds, and thus healing it by the application of mucus, I should hardly have thought it necessary to refute the story, were it not that some modern authors are inclined to think there is some truth at the bottom of it.

> "The Pike, fell tyrant of the liquid plain,
> With ravenous waste devours his fellow train;
> Yet, howsoe'er by raging famine pined,
> The Tench he spares—a medicinal kind;
> For when, by wounds distrest or sore disease,
> He courts the salutary fish for ease,
> Close to his scales the kind physician glides
> And sweats a healing balsam from his sides."

That Pike may prefer one kind of fish to another is not only probable in theory, but known as a fact, and it is likely enough that this "fell tyrant of the liquid plain" would rather dine on a fat Gudgeon or bright-scaled Dace than on a slimy Tench; but it is not true that the Pike refuses to swallow Tench; I have frequently caught Pike when trolling with a small Tench, and others have the same experience. Moreover, the late Rev. W. Bree gives the following evidence, which is pretty conclusive:—"I turned into a pit fifty-seven small Tench, and upwards of three score Crucian Carps; and not a great while afterwards,

having discovered the presence of Pikes in this piece of water, a net was employed, with which three of that species were taken, which weighed respectively about three pounds, two, and a pound and a half; but all that remained of the other fishes which had been placed in this pond were one Tench that weighed a pound and a half, and eight Crucians of about a pound each. I cannot have the smallest doubt that the Pike devoured the fish that were missing, and those nine that remained only escaped because they were rather too large for these Pikes to swallow."—(*Zoologist*, 1853, p. 4125.)

When a Pike is hungry, in that frantic state so well described by Charles Kingsley as partly induced by the north-east wind,

> "Hungering into madness
> Every plunging Pike,"

almost any kind of food is acceptable; water-voles, rats, young ducks, little goslings, young moorhens, dabchicks, and fish of all kinds enter into a Pike's food-list; besides garbage occasionally; and even it is on record that the head of a swan, as the bird was feeding under water, has been seized by one of these ravenous fish. Toads seem to be the only creatures the Pike refuses to swallow.

Pike spawn in March and April, and sometimes in February; Siebold gives April and May; there is doubtless difference as to time in this respect. The roe is small, and in canals and ponds is deposited among the weeds; where possible, a pair of Pike will seek the small bays, creeks, and shallows of the waters inhabited by them, and place their spawn there, returning after the season to more open waters. The young are said to be produced in about thirty days, and their growth to be rapid; but of course growth depends in a great measure on the amount and quality of food they can get.

The size to which Pike, under favourable circumstances, will attain, is very considerable. The largest on record is the one mentioned by Gesner, who relates that in the year 1497 a Pike was caught in a pool near Hailprun (Heilbronn) in Suabia (Neckar-Kreis, Würtemberg), with a brass ring fixed in the skin under the gills, a portion of which ring was still bright. Gesner gives a figure of this ring, which is before me as I write; its diameter, measuring from the outer periphery, is just three inches and a half; the breadth of the margin is just a quarter of an inch; at the bottom of the ring is a double series of round metal balls of the size of large peas, three in each series, which is separated by an interval, and the balls are attached to the ring each by a pedicle; engraved round the margin of the ring is a Greek inscription, easily read, the translation of which is as follows:—"I am that fish that was first put into this lake by the hands of the Emperor Frederick the Second, on the fifth day of October, 1230." On the top of this ring a smaller one was fastened, by which it was attached to the fish. The six circular balls are supposed, by Gesner, to signify the Imperial Electors. The diameter of the smaller ring is an inch and five-eighths; its margin is a quarter of an inch in breadth. If this story is correct, the Pike in question would have been two hundred and sixty-seven years old from the time it was placed in the lake; it is said to have weighed three hundred and fifty pounds, but I do not find this on the authority of Gesner. Mr. Cholmondeley Pennell, who has very accurately reproduced old Gesner's figure of the ring, with its inscription, mentions one Leham, who had seen a drawing of both Pike and ring, in a tower on the road between Heilbronn and Spires; this writer says that as late as the year 1612 the water from which the Pike was taken was still named *Kaiserwag* (?) or the Emperor's Lake. "The ring and the skeleton of the Pike," adds Mr. Pennell, "are stated to have been long preserved in the cathedral at Mannheim, the skeleton measuring nineteen feet; but upon subsequent examination by a clever anatomist, it was discovered that the bones had been lengthened to fit the story—in other words, that

several vertebræ had been added." Considering that we have authentic records of Pike attaining to the weights of forty, seventy, and even ninety pounds, there seems no reason to disbelieve entirely the old "Ring-story." As Mr. Pennell says, "taking all the circumstances of the case into consideration, as well as the amount of concurrent testimony produced, there appears to be no reason to doubt that a Pike of extraordinary size and age was actually taken at the place and time stated. It is to be observed, in estimating the probabilities of the narrative, that it was certainly the custom in earlier times to put metal rings into the gill-covers of fish; and as late as 1610 a Pike was taken in the Meuse bearing a copper ring, on which was engraved the name of the city of Stavern and the date of 1448."—(*Angler Naturalist*, p. 190.)

One of the largest recorded British Pike was taken in Loch Ken, Kirkcudbrightshire; it is mentioned in Daniell's *Rural Sports* and by other writers. The head is now in the possession of the Hon. Mrs. Bellamy Gordon, of Kenmure Castle, Kirkcudbrightshire, to whom I am indebted for some particulars concerning this monster fish. It is said to have weighed over seventy-two pounds, and to have been about seven feet in length.* The Pike from some of the Continental lakes, however, exceed even this weight. Dr. Genzik, of Lintz, assures Mr. Pennell that in the fish markets there, as well as in those of Vienna and Munich, Pike of eighty and ninety pounds weight and upwards are not unfrequently exposed for sale; the same gentleman saw a Pike taken at Oberneukirchen which after being cleaned weighed ninety-seven pounds and some ounces; and he was informed by an officer of Tyrolese Rifles that he was present when in 1862 a fish was caught at Bregentz of more than one hundred and forty-five pounds weight.

Large Pike are not unfrequently caught in the pools at Weston Park, Shropshire, the seat of the Earl of Bradford. His lordship mentions to me a specimen of Pike in his possession which weighed thirty-seven pounds and a half. "One year," he says, "I remember taking two at the same time which weighed thirty and thirty-three pounds." In Mr. Frank Buckland's Museum, South Kensington, several casts of Pike, admirably executed and well coloured, may be seen; I particularly noted one fish, of thirty-five pounds weight, caught in a net at Rabley Lake, Windsor, in October, 1874. It must have been in splendid condition; the breadth and depth were enormous. There is also a cast of one Pike being partly swallowed by another; the pair weighed nineteen pounds; both were found dead in Loch Tay in 1870. As Mr. Buckland remarks, "they were probably charging at the same bait."

As to the quality of the flesh of this fish there is much difference of opinion; some persons will not eat it on any account, others regard it as most excellent food. In the case of Pike, as in that of fresh-water fish generally, much depends on the waters inhabited, the amount of food, and the time of the year. A Pike of four, six, or ten pounds weight, taken out of a river where White Fish and other kinds abound is almost always, in my opinion, a good fish; the same may be said of Pike taken from lakes and large ponds well supplied with food; but Pike taken from small muddy pools insufficiently stocked with other fish, and caught soon after spawning, are worthless, I confess, and such specimens, I suspect, must have come under the notice of the Roman poet who, as we have seen, considered the Pike unworthy of a gentleman's table, and fit only to "steam away with unpleasant odour in smoky cookshops."

Trolling for Pike is a sport which is deservedly in high favour with anglers generally; the baits employed are Roach, Dace, Perch, Bleak, Gudgeon, and small Tench—a Goldfish is an attractive lure. Pike are sometimes caught with a large artificial fly, as in Salmon fishing.

* The Honourable Mrs. Bellamy Gordon tells me that this fish, which was caught about one hundred and twenty years ago by John Murray, keeper at Kenmure, was taken by an artificial fly made of peacocks' feathers; that the head has lost some of its bones, and that in consequence it looks smaller than it used to do, but that it is still large in comparison to the head of a Pike of twenty-seven pounds weight also caught in Loch Ken about forty years ago, and preserved in the same case.

In discoloured water the spoon bait is often very effective. But I must refer my readers, who require information on such points, to Mr. Cholmondeley Pennell's *Book of the Pike* and to Mr. Francis Francis's *Book on Angling*, where the fullest information and instruction will be found.

The body of the Pike is elongated, of uniform depth from the shoulder to the origin of the dorsal fin, then narrowing; the head flat and wide; under jaw the longest; gape excessively wide; eyes large and prominent; distinct mucous pores on the lower jaw, as also on the upper surface of the head. The dorsal fin and the anal are very far back, and are opposite; tail forked and broad. Colour of head and upper part of the back olive brown, becoming lighter on the sides, and broadly specked or mottled with green or yellowish green, with many scattered roundish yellow spots; belly white or silvery white.

The fin-ray formula is

Dorsal 19.
Pectoral 15.
Ventral 10.
Anal 19.

The name of Pike doubtless alludes to the length and shape of this fish's body. In Halliwell's *Dictionary of Archaic Words* we learn that Luce was generally applied to large full-grown fish, in the last stage of life; "first a Jack, then a Pickerel, thirdly a Pike, and last of all a Luce." "The Pike of the fisherman," says Yarrell, "is the Lucie of heraldry, from the Latin or old French name. Three silver Pikes in a red field were the arms of the ancient baronial families of Lucie of Cockermouth and Egremont." Shakespeare (*Merry Wives of Windsor*, i. 1,) refers to this fish in the arms of Sir Thomas Lucy, of Charlecote, Warwickshire.

A fine specimen was presented for the use of this work by Major Brooksbank, of Middleton Hall.

SALMONIDÆ.

DR. GUNTHER has well remarked that "the *Salmonidæ* and the vast literature on this family offer so many and so great difficulties to the ichthyologist, that as much patience and time are required for the investigation of a single species as in other fishes for that of a whole family. The ordinary method followed by naturalists in distinguishing and determining species is here utterly inadequate; and I do not hesitate to assert that no one, however experienced in the study of other families of fishes, will be able to find his way through this labyrinth of varieties without long preliminary study, and without a good collection for constant comparison. Sometimes forms are met with so peculiarly and constantly characterized, that no ichthyologist who has seen them will deny them specific rank; but in numerous other cases one is much tempted to ask whether we have not to deal with a family, which, being one of the most recent creation,* is composed of forms not yet specifically differentiated."

The difficulties here spoken of by Dr. Günther, in his preface to the sixth volume of his *Catalogue of the Fishes in the British Museum* (London, 1866), have been in a great measure overcome, thanks to the great knowledge and the laborious patience of the eminent ichthyologist himself, and although no doubt a good many questions relating to the life history of some of the members of this family remain at present unanswered, yet it may be safely asserted that Dr. Günther has successfully combated most of the difficulties which beset the study of the *Salmonidæ*, and that in him we have an excellent and most trustworthy guide in threading our way through what was before, what he so well describes, a labyrinth of confusing variations. I was well aware of some of these difficult questions before I undertook to write this present work, and therefore from the very day almost on which I embarked, I kept my eye and mind almost without intermission on questions relating to this family of the *Salmonidæ;* I have visited various parts of England, Wales, and Ireland, in order to make enquiries, and especially to procure specimens, and on the whole I may congratulate myself on my success.

Under the family name of British *Salmonidæ* are included the various species of Salmon proper, whether migratory or non-migratory, the Charrs of the North of England and of Wales, the Pollan, the Gwyniad, and the Vendace of Ireland, Wales, and Scotland respectively,

* "No fossil true *Salmo* is known at present; the nearest fossil approaching to it is a *Mallotus*."

the Grayling, and the Sparling, or Smelt. But it is only in the first sub-generic group (*Salmones*) that we meet with such infinite variations as to cause the difficulties alluded to; these variations are dependent on age, sex, and sexual development, and the properties of the water, as Günther has remarked. There is, however, another fact in the history of some of them which serves still further to increase complications, and that is that some of these Salmonoids interbreed.

As to points of variation we find that there is great difference in the *colouration* between the different individuals of the same species. Again, colouration varies in the *same* individual, according to age and sexual development; thus the young of the Salmon, as indeed of all the *Salmonidæ* perhaps, are striped transversely with dark bars; the colour of a male or a female Salmon in the spawning season (November, December,) is often adorned with various tints of red, yellow, and blue, totally unlike the colouration of the same fish earlier in the year with its bright silvery scales. "Nimium ne crede colori" must ever be remembered, because colour rarely assists in distinguishing a species, there being perhaps not one which has the same colour at all periods of its life.

The *size* of some of the *Salmonidæ* is subject to variation; and this depends mainly, if not entirely, on the amount of food to be obtained. I have seen a Trout two years old, taken out of a fair-sized piece of water where food was abundant, which weighed nearly three-quarters of a pound; whereas another individual of the same age, which had lived in a small pond with many other Trout for the same length of time and with little food, would weigh not more than two ounces and a half.

Structural variation occurs in the snout in a most marked degree. The long pointed snout of a male ready to spawn is different from that organ before the milt is matured; so in the form of the mandible or lower jaw, which in the breeding season is generally bent upwards, there is great difference. The tail, moreover, is subject to variation; in young specimens, in the parr state, that organ is always more or less deeply incised in all the species of *Salmo;* in the grilse state the tail is still incised, but not so deeply as in the parr state, whilst in a full grown Salmon the tail is almost square; so that here we should follow a very fallacious guide did we fail to remember that variation occurs relating to the age and the sexual development of the fish. But not only is the caudal fin thus liable to structural variation; we are assured by Dr. Günther that the form and length of all the fins may vary. Species inhabiting rapid streams, as well as still waters, show considerable variations; "those individuals which live in rapid streams, being in almost constant motion, and wearing off the delicate extremities of the fins, have the fin rays comparatively shorter and stouter, and the fins of a more rounded form, particularly at the corners, than individuals inhabiting ponds or lakes; moreover, one and the same individual may pass a part of its life in a lake, and enter a river at certain periods, thus changing the form of its fins almost periodically."—(P. 5.)

In the *texture* of the surface of the body variation occurs. In old males the epidermis is always tough during the spawning season, the scales are more or less deeply imbedded in the skin, and therefore not easily deciduous; this is not the case at other seasons of the year.

Thus it will be seen that in all these instances of variation, whether in colouration or in structure, it would be unsafe to depend on them as guides in discriminating species, because such characters are not constant; they are variable according to the age and sexual development of the fish. But it may be asked, have we no reliable guides on which to depend? Are there no constant characters? Dr. Günther draws attention to the following points upon which, he thinks, the chief stress should be made in discriminating species.

1. "The form of the præoperculum of the adult fish." This will be readily seen by the subjoined woodcut. *a* is the præoperculum of the Sewen (*S. cambricus*), which at *a** has

a distinct and well-developed lower limb; *b* is that of *S. brachypoma*, which at *b** has scarcely a trace of a lower limb. This character may be said to be constant, and I have always

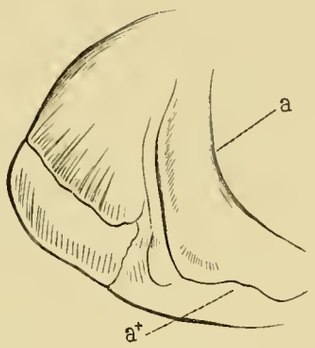
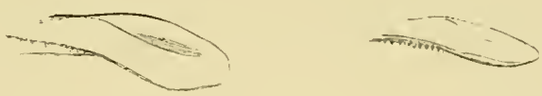




Fig. 1. (After Günther.) Fig. 2.

found it a safe guide in discrimination. It should be remembered, however, that in the young of all the Salmonoids the præoperculum has a short lower limb, and that whilst "in some species it lengthens with age, its development in a horizontal direction is arrested in others."

2. "The width and strength of the maxillary of the adult fish." This character is well shown in the accompanying woodcuts. *a* is the maxillary or upper jaw of the Common Trout, *b* that of the Lochleven Trout, each fish being of the same size, namely, twelve



a, Common Trout. *b*, Lochleven Trout.
(After Günther.)

inches long. I have before me a young specimen of the Common Brown Trout with parr marks distinct, from Ellerton Hall; it is about four inches long. I have also before me a parr Salmonoid from the Dee, near Min-yr-Afon, the residence of Mr. Bigge, caught in August, 1878; it is about five inches in length. The young parr state in all the Salmon family is very similar, and a general examination of the young of the different species would fail to detect any difference. Now in the first of these two specimens (*S. fario*) the maxillary reaches almost to a level with the posterior orbit of the eye; in the Dee Salmonoid the maxillary reaches only to the centre of the eye. Here is a most important character, for I know at once that this young Dee Salmonoid is the parr state of the *Salmo cambricus*. There are other indications as to this being the species, but I pass over them for the present.

3. "The size of the teeth, those of the intermaxillaries excepted."

4. "The arrangement and the permanence or deciduousness of the vomerine teeth." This is a character of some importance; in some species the teeth are arranged on the vomer in a double series, in others in a single one; but as the teeth forming a single series are often arranged alternately, or in a kind of zigzag way, presenting somewhat the appearance of a double series, and other irregularities also occur, a definite arrangement is not always evident. In some fish these vomerine teeth are persistent, in others deciduous.

5. "The form of the caudal fin in specimens of a given size, age, and sexual development."

6. "A great development of the pectoral fins when constant in individuals from the same locality."

7. "The size of the scales, as indicated by the number of transverse rows above the lateral line." Dr. Günther regards this as one of the most constant characters.

8. "The number of vertebræ; the constancy of this character is truly surprising, excess or diminution in the number being of rare occurrence."

9. "The number of pyloric appendages." In some species the number varies from thirty to fifty; in others, as in the Salmon and Charr, it is very constant; in the Lochleven Trout these cæcal appendages are generally very numerous, from seventy to ninety; and where the normal number is diminished, this has been brought about by the confluence of some of the cæca. I may mention a striking instance of the value of this character in the case of the Galway Sea Trout (*Salmo gallivensis*); in a specimen before me, a fish about ten inches long, the pyloric appendages are very short, the longest is not more than half an inch, and about a line in diameter.

Certain points in the life history of the Salmon or other species of the *Salmonidæ* which yet remain obscure will be noticed in the accounts of the different fish as they come before me. I give here a tabular arrangement of the various species of British *Salmonidæ*, which I hope will be found useful.

SALMONIDÆ.

FIRST GROUP—SALMONINA.

First Sub-generic Group—SALMONES.

MIGRATORY SPECIES.

Salmo salar, Lin., (Salmon.)
S. trutta, Flem., (Salmon- or Sea-Trout.)
S. cambricus, Donov., (Sewen.)
S. brachypoma, Gthr., (Short-headed Salmon.)
S. gallivensis, Gthr., (Galway Sea-Trout.)
S. argenteus, Cuv. & Valenc., (Silver Salmon.)
S. eriox, Yar., (Bull Trout of the Coquet.)

NON-MIGRATORY SPECIES.

Salmo fario, Lin., (Common Brown Trout.)
S. ferox, Jard. & Selby, (Great Lake or Black Lough Trout.)
S. stomachicus, Gthr., (Gillaroo Trout.)
S. nigripinnis, Gthr., (The Black-Fin.)
S. levenensis, Walk., (Lochleven Trout.)

Second Sub-generic Group—SALVELINI.

NON-MIGRATORY SPECIES.

Salmo alpinus, Lin., (Alpine Charr.)
S. willughbyi, Gthr., (Windermere Charr.)
S. perisii, Gthr., (Llanberris Charr.)
S. grayii, Gthr., (Gray's Charr.)
S. colei, Gthr., (Lord Enniskillen's Charr.)
S. killinensis, Gthr., (Loch Killin Charr.)

Coregonus clupeoides, Lac., (Gwyniad of Bala.)
C. pollan, Thomps., (Pollan, or Fresh-water Herring of Ireland.)
C. vandesius, Rich., (Vendace of Loch Maben, Dumfriesshire.)

Thymallus vulgaris, Nilss., (Grayling.)

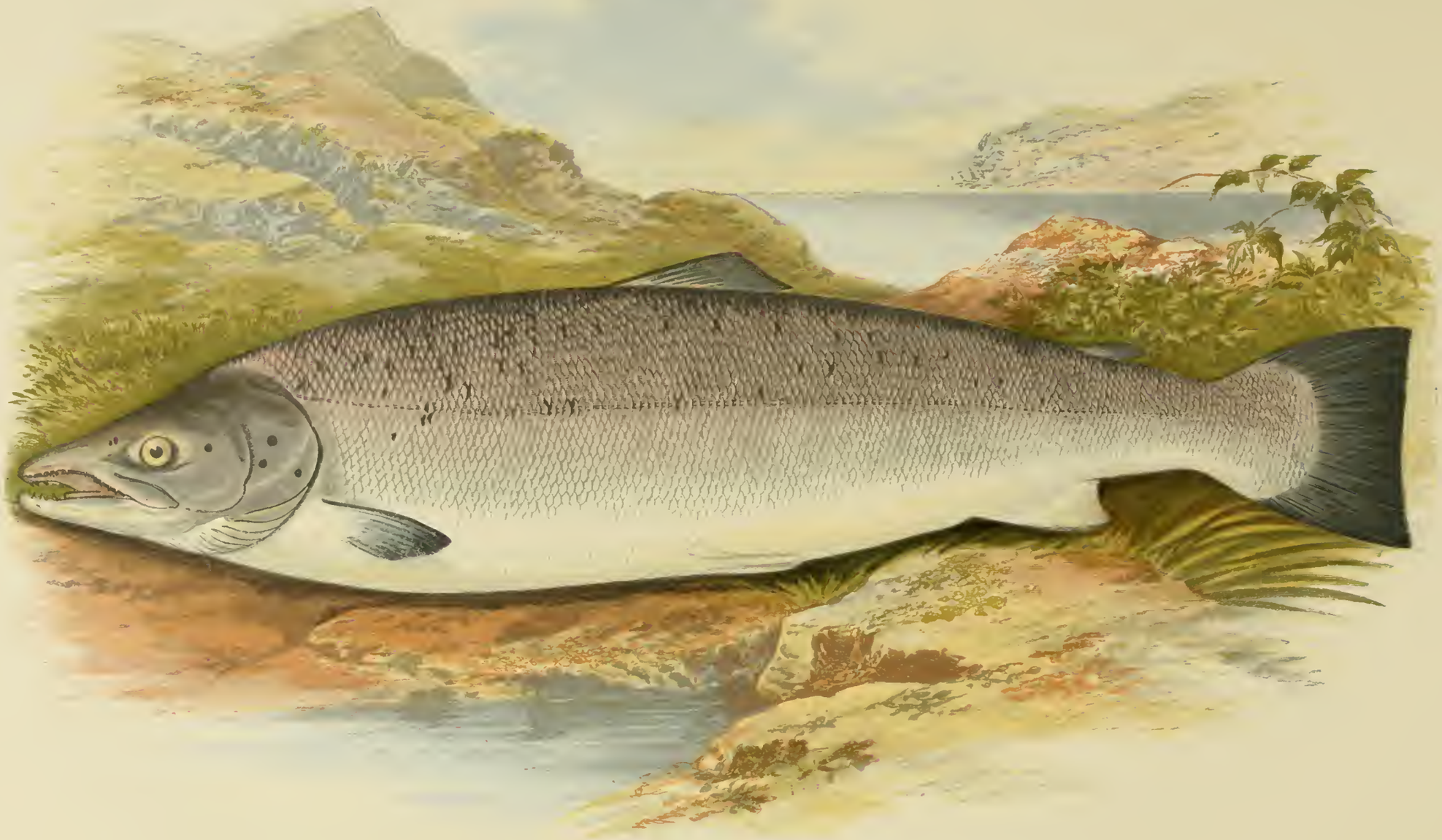
MIGRATORY OR NON-MIGRATORY.

Osmerus eperlanus, Lin., (Smelt or Sparling.)

SECOND GROUP—SALANGINA.

No British species; (rivers and seas of China and Japan.)

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SALMON (MALE)



On the Tweed.

Order IV.
PHYSOSTOMI

Family
SALMONIDÆ.
Sub-generic group—Salmones.

Salmon.

(Salmo salar.)

Salmo fluviatilis,	Pliny, Nat. Hist. ix. 18.
Salmo,	Ausonius, Id. x. l. 97; Willughby, Hist. Pisc. p. 189.
Salmo rostro ultra inferiorem maxillam sæpe prominente,	Artedi, Spec. Pisc. p. 22 No. 1.
Salmo salar,	Flem., Brit. An. p. 169; Jenyns' Man. p. 421; Yarrell, ii. p. 1; Parnell, Fish. of Firth of Forth, p. 278 (Wern. Nat. Hist. Soc.); Günther's Cat. vi. p. 11.
Salmon,	Pennant, Brit. Zool. iii. p. 382 ed. 1812; Couch, Fish. Brit. Isl. iv. p. 163; Alex. Russel, Edmonston and Douglas, 1864.
Salmulus,	Ray, Syn. Pisc. p. 63.
Salmo salmulus,	Jenyns' Man. p. 426; Parnell, Wern. Nat. Hist. Soc. p. 298.
Salmo gracilis,	Couch, Fish. Brit. Isl. iv. p. 216.
Samlet and *Parr,*	Pennant, Brit. Fish. iii. p. 404 ed. 1812; Yarrell, ii. p. 83; Couch, Fish. Brit. Isl. iv. 245 pl. 221.
Trutta salar,	Siebold, Süsserwasserf. p. 292.

Characters of the Genus Salmo.—"Body covered with small scales; cleft of the mouth wide, the maxillary extending to below or beyond the eye. Dentition well developed; conical teeth in the jaw bones, on the vomer and palatines, and on the tongue, none on the pterygoid bones. Anal short, with less than fourteen rays. Pyloric appendages numerous; ova large."—Günther.

Characters of the Sub-generic Group SALMONES.—"Teeth not only on the head of the vomer, but also along its body; in a few species the posterior teeth are lost with age, and only a more or less conspicuous ridge remains along the median line of the bone, which becomes visible after removal of the membrane."—GÜNTHER.

THE Salmon, "the King of Fresh-water Fish," as old Izaak Walton rightly calls him, was unknown to the ancient Greeks; being chiefly a northern fish, and not found in the Mediterranean, it did not come within their knowledge. Pliny and Ausonius amongst Roman writers allude to the Salmon; the former merely states that "in Aquitania the River-Salmon is preferred to all sea fish." Ausonius gives a very good description of a Salmon, and doubtless had both seen its movements in the Moselle and had tasted its delicious flesh, as is evident from his lines—

"Nec te puniceo rutilantem viscere, Salmo
Transierim, latæ cujus vaga verbera caudæ
Gurgite de medio summas referuntur in undas,
Occultus placido cum proditur æquore pulsus.
Tu loricato squamosus pectore, frontem
Lubricus, et dubiæ facturus fercula cœnæ,
Tempora longarum fers incorrupta morarum,
Præsignis maculis capitis, cui prodiga nutat
Alvus, opimatoque fluens abdomine venter." (97—105.)

"Nor will I pass over thee, O Salmon, blushing with thy red flesh, the roving strokes of whose broad tail are borne from the middle of the stream to the top of the water, at such time as the hidden lash betrays itself on the calm surface. Thou, clothed in scaly armour, slippery as to thy fore part, and able to constitute a remove for a most excellent dinner,* dost bear keeping fresh for a long time; thou art conspicuous with thy spotted head; thy full paunch trembles, and thy belly overflows with abdominal fat."

My own translation is literal. Pennant gives the following in blank verse, but with less faithfulness to the original:—

"Nor I thy scarlet belly will omit,
O Salmon, whose broad tail with whisking strokes
Bears thee up from the bottom of the stream
Quick to the surface: and the secret lash
Below, betrays thee in the placid deep.
Arm'd in thy flaky mail, thy glossy snout
Slippery escapes the fisher's fingers; else
Thou makest a feast for nicest-judging palates;
And yet long uncorrupted thou remainest:
With spotted head remarked, and wavy spread
Of paunch immense o'erflowing wide with fat."
Anonymous (*Brit. Zool.* iii. p. 383-4, ed. 1812.)

The Salmon is an inhabitant of the fresh waters of the northern and temperate parts of the world, occurring in Scandinavia, Iceland, Russia, Germany, Holland, France, Great Britain, and North America. It is said also to occur in Northern Asia. Its geographical range in temperate Europe reaches to about 43° north latitude; it extends southwards to the Bay of Biscay, and appears to inhabit Northern Asia and America to latitude 41° north. It does not occur in any of the rivers which flow into the Mediterranean. It is migratory in its habits, descending to the sea after it has deposited its spawn on the gravelly beds of the rivers. "The natural history of the Salmon," as Mr. Russel well says, "is not only interesting in itself—interesting for what is known and settled, for what is guessed and controverted, and for what remains as utter mystery and dire perplexity—but is also important as having a bearing upon, or rather forming an essential part of the commercial and legislative questions."

* The *dubia cœna* of the Romans implied so many good things that you did not know what to choose.

It has long been a disputed point as to whether the parr is the young of *Salmo salar* or a distinct species. There are, I believe, some people who still persistently maintain that the parr is not the young of the Salmon, but a distinct species, notwithstanding the evidence derived from the careful experiments of Mr. John Shaw, of Drumlanrig, in the years 1833-6, who proved beyond a shadow of doubt that the parr was a young Salmon. This gentleman, in a valuable memoir, before me as I write, succeeded in tracing the life history of the Salmon from the egg up to its smolt stage of two years' growth.

The diameter of the ovum of a Salmon is one fourth of an inch; according to Mr. F. Buckland every female Salmon carries as a rule, about nine hundred eggs to a pound of her weight; the spawning time is in November and December; "the female throws herself on her side, and while in that position, by the rapid action of her tail, she digs a receptacle in the ground for her ova, a portion of which she deposits, and again turning upon her side, she covers it up by a renewed action of the tail—thus alternately digging, depositing and covering ova, until the process is completed by the laying of the whole mass, an occupation which generally occupies three or four days."—(*Experimental Observations on the Development and Growth of Salmon Fry*, p. 565.) The only part the male fish performs, beyond the mere sexual function, consists in the unwearied vigilance which he exhibits in protecting the spawning-bed from the intrusion of rival males, all of which he assiduously endeavours to expel. The hatching period lasts from ninety to one hundred and thirty days, according as the temperature of the water facilitates or retards the development of the spawn. In a temperature of 40° the fish has been observed to be hatched the one hundred and eighth day after impregnation; when the temperature did not exceed 33°, the hatching did not take place till one hundred and thirty-one days after impregnation, though in this case the temperature of the river during the last forty days of that period had risen to an elevation of 60°. According to Mr. Shaw's experiments the growth of the Salmon is as follows, though no doubt this growth is not the same in all individuals, some growing faster than others. A young Salmon, with its attached umbilical sack of one day old, is about seven eighths of an inch in length; at two months old it has attained the size of about one inch and three quarters, and bears many transverse dark bars; the little fish is at this stage called a parr; at four months of age the young Salmon, or parr, is two inches and three eighths long; at six months about three inches; at twelve months four inches and a quarter; at eighteen months it is nearly five inches and a half, still bearing the parr marks; at two years it attains the size of six inches, the parr marks now disappearing, or being only faintly visible, and the fish assuming the characteristic aspect of the smolt, commonly so called. In this latter's stage the young fish is in colour and form very like the parent Salmon; it is in this stage also that it rises most readily to an artificial fly, and used to be caught by the angler in large quantities before the law interfered with its capture.

The sexual development of the male is subject to variety, for in some cases young smolts of seven or eight inches long have their milt fully developed, and attend the older fish on the spawning beds. Mr. Shaw succeeded in impregnating Salmon-ova with the milt of the male parr in several instances. With the young female smolt the case appears to be different, for the female smolt does not mature her ova. "No parr," says Günther, "has ever been found with mature ova." "Some advocates for the opinion of the specific distinctness of the parr," he adds, "pretend indeed to have found female parrs. Those fish which were pointed out to me as females were invariably specimens which had fed freely on the ova of their congeners, and their stomachs had been regarded as the ovary! Some persons were so anxious to convince me of the correctness of their opinion, that they sent me specimens with ova in the abdominal cavity. On closer examination these fishes turned out to be immature *male* specimens, the ova having been introduced by a cut into the abdomen, said to have been made to admit the spirit."—(*Catalogue*, vi. p. 9, note.) It may, of course, be asked, why may not the females

occasionally mature their ova as the males do their milt? Mr. Shaw says that solitary instances have occurred of large female parrs having been found in Salmon rivers with the roe considerably developed, "and I find," he adds, "by detaining the female smolts in fresh water until the end of the third winter, that individuals are found in this comparatively mature condition."

Without denying the possibility of the female smolt partially maturing the ova, it must be admitted that no case has been brought forward in which a female smolt has been shown to have ova fully developed and ripe for impregnation. Even if such an instance should ever be proved, it does not follow that the parr is a distinct fish. The large parr, nine or ten inches in length, occasionally found in rivers, are simply the young of the Salmon, which, not being ready for migration at the usual time, had remained for another year in the fresh water of the river, and feeding, as we know they do, voraciously in this stage, it is possible that a female smolt may occasionally partially develope the ova.

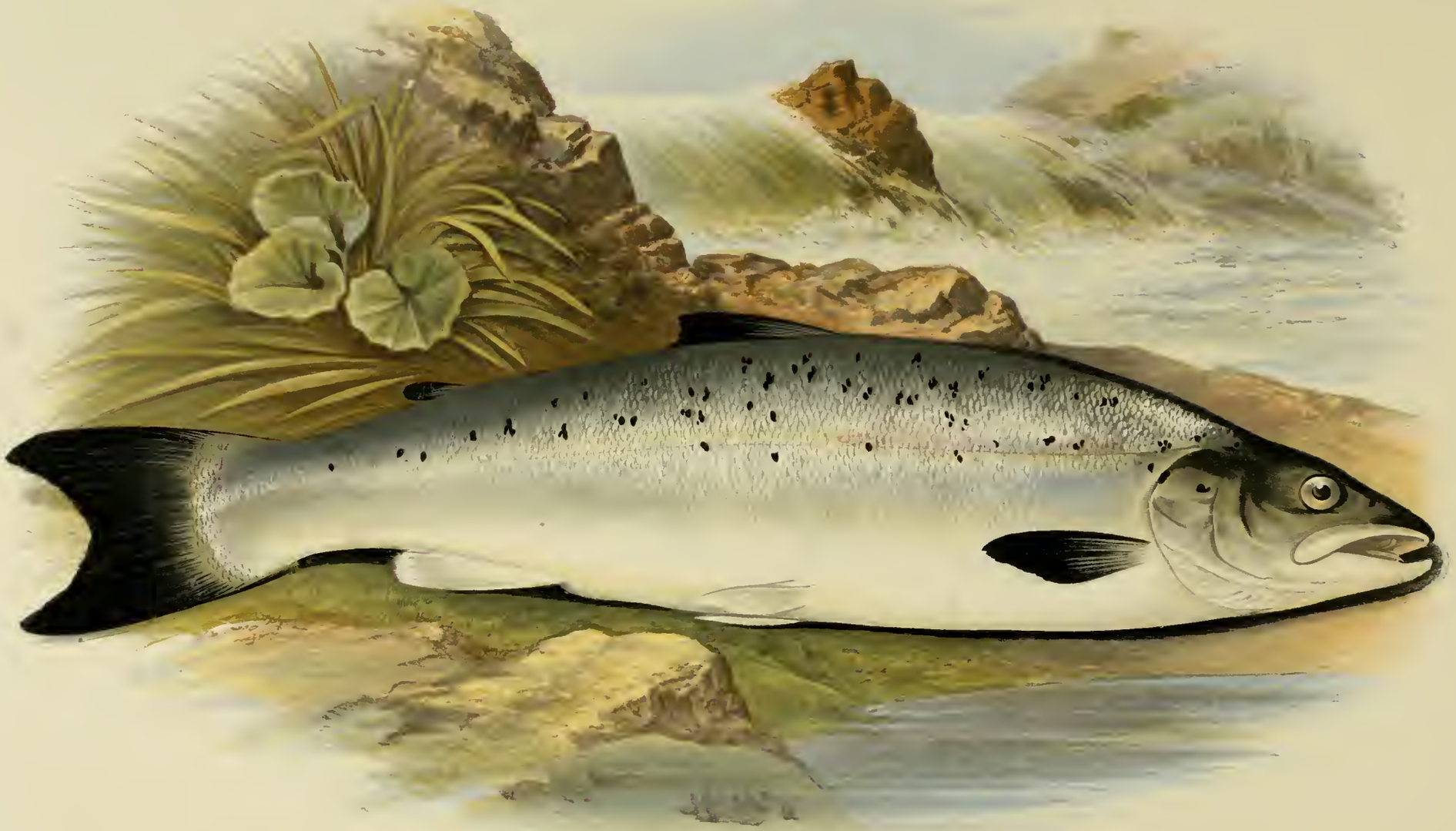
As to the length of time during which Salmon-fry remain in the rivers before they descend to the sea, it would appear from experiments made at Stormontfield, on the Tay, in 1853-4, that there is, in this respect, a great amount of variation even amongst individuals living under the same apparent conditions; it seems that a considerable number of young fish descend to the sea when they are about fifteen months old.* A parr hatched in February, 1878, say, may be ready to take its journey seawards in May or June, 1879; it has also been shown that a large number remain in the river till they are a little over two years old; a parr hatched in February, 1868, may remain in the fresh water till May or June, 1870, and I suspect that this is usually the case.

The young Salmon after remaining for some time in the sea returns to the river; it is then called a grilse. How long does it remain in the sea before it returns to the fresh-water? In experiments made at Stormontfield, a great number of smolts were marked by cutting off the adipose fin, others by cutting the tail, and others by the fixing of silver rings. Between twelve and thirteen hundred smolts were marked by cutting off the adipose fin and turned out of the pond the first year, of these twenty-two are stated to have been caught as grilse that same season; of those that left the pond the second year eleven hundred and thirty-five were marked by cutting the tail, and of these several are reported to have been caught as grilse in the course of their season. "Of all the smolts marked by the attachment of rings or other effective means," says Mr. Russel, "whether in the Tay or other rivers, *none have been got*, as either grilse or Salmon, *the first year*, and *several have been got the second year*. Of the Stormontfield smolts of the second year—descending in spring, 1856—three hundred were marked by silver rings, and of those none were got. It is quite possible indeed that all of the three hundred that escaped their enemies in the sea, or even, we will suppose, the entire three hundred, 'no wanderer lost,' may have returned to the Tay as grilse that season, and yet none of them have chanced to be caught. But from other quarters we have what seems positive evidence in favour of the second season.

In various years a great number of Tweed smolts were marked by a silver wire passed through and fastened to the back part of their tails; none of them were got as grilse or Salmon the season they were marked, but the next season several of them were caught as most indubitable grilses. Still later experiments on the Tweed, apparently on a smaller scale, but conducted with great care, have brought out the same results. The Duke of Roxburghe has preserved in his possession a fish which was marked as a smolt by the insertion of a peculiarly shaped wire on the 14th. of May, 1855, and which was caught on July 21st. of the *following* year as a grilse weighing six pounds and a half. The more

* I do not believe, as some have maintained, but never proved, that a young fish ever grows so fast as to be able to descend to the sea in the same year as that in which it was hatched.

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...LE, OR YOUNG SALMON.

recent experiments of Mr. Ramsbottom, of Drohulla, have also gone to support the doctrine that the fish does not return until after thirteen to fifteen months in the sea; smolts turned out of the nursery ponds and marked in May, 1862, having been caught as grilse in June, July, and August, 1863, though there is in this case a possibility that the smolts may have been turned out before they were ready to emigrate, and may after their expulsion have spent in the river one of the two years which Mr. Ramsbottom assumes that they spent in the sea. To what conclusion, then, on this point do these experiments conduct us? To nothing absolutely certain; but as a probability, supported by evidence small in amount, but strong in quality, to this—that some at least of the smolts do not ascend as grilse, or as anything else, till *next* year, or fifteen months after their descent; and as another probability, supported by evidence greater in amount, but not so strong in quality, that some of them return the *first* year, or three months after descent. It may then be that both views are correct."—(*Natural Hist. of the Salmon*, p. 54-56.)

Growth in a grilse or young Salmon takes place very rapidly during its sojourn in the sea; this is no doubt owing largely to the abundance of food in the form of Sand-eels, young Herrings, Shrimps, etc., etc. I have taken as many as five large Herrings out of the stomach of a Salmon that had been caught in the sea; indeed I have invariably found sea fish to have their stomachs full of food, whereas I have never been able to detect a particle of food in a river fish. A smolt descending to the sea weighing only a few ounces may return to the river weighing six, eight, or even fourteen pounds after some time feeding in salt water. A remarkable instance of rapidity of growth is given on the authority of the Duke of Athol (*Quarterly Review*, April, 1863). The fish caught was first caught as a grilse forty miles from the sea on the 31st. of March; it then weighed ten pounds. It went down to the sea, and returned again in the short space of thirty-seven days, when it was again caught; it weighed twenty-one pounds and a quarter. This fact of a grilse returning so soon to the river a second time would seem to show that the same individual may change the salt for fresh water several times in the year, as thought probable by Dr. Günther. It is well known, that although the majority of the mature individuals ascend a river during floods at a fixed period, for the especial purpose of spawning, others, either singly or in troups, enter the fresh water early in the year, and indeed continue to come up every month in the year. The cause of these non-periodic ascents to the river is unknown. These early or clean-run fish of the spring months are always found to be in excellent condition; they are very fat, not only in the substance of their flesh, but in the large quantity of adipose matter which is found on the pyloric appendages; this serves as an internal source of sustenance which supports the fish in its sojourn in the fresh water where it scarcely ever feeds. These clean-run spring fish avail themselves of the spring floods and enter some of our rivers; but whether they remain in the fresh water from March to November,—the spawning season,—or whether, in some cases, they go down again to the sea before spawning, one cannot say. It seems a long while for the internal supply of fat to last a fish—from March to November—without food. "These fish," as Mr. F. Buckland says, "if there had been no floods in the spring, would probably have remained in the sea, and would have appeared in the river either in the first floods in July or August, or if there were no floods in these months, they would have come up in November and December as large fish, which, as experience shows, are generally the latest to come into the river, and which for the most part spawn in the lower portions of the river."—(*Famil. Hist. Brit. Fish.*, p. 369.)

The question of early and late rivers is a very important one; according to the present law it is illegal to take Salmon with a net after the end of August, the fishing beginning again in February. This law "applies to all rivers, little or big," as Mr. Buckland says, "those that run long courses and those that are of short length, those that have lakes at or near their origin, those whose tributaries are simply rivulets rising high up in the

mountains, and those which have long reaches of spawning-grounds.....There are rivers which Salmon never enter till the end of June and during July, August, and September; their numbers then increase during October and November; to the fishermen of these rivers the months of February, March, (and often April,) are of no commercial use whatever; nor do the anglers even profit, because the waters contain not clean-run 'up fish,' but only 'down fish' that have lately spawned, and are not fit either for food or sport. The fishermen on these rivers, therefore, are anxious to be allowed to prolong their netting season into September, and in some cases even further; and at the same time they are willing to give up fishing altogether in February and March, and in many cases even in April."—(P. 370.) The same authority is of opinion that *the presence of a lake at the head of a river* has a great influence in causing an early ascent of Salmon, as its "innate self-preserving faculty prompts the Salmon to leave the security of the sea and make a run for the lake at the head of the river, which it somehow knows exists—a most marvellous faculty, a faculty not possessed by man—and wherein its instinct teaches it that it will be safe till the spawning time arrives, when it can run up the tributaries of the lake." Mr. Buckland instances the Tay as being proverbially an early river, fresh-run fish being found in Loch Tay as early as January; on the other hand he adduces the river Conway as a good example of a late river; in this case there is no lake at the head of the river, but there is a broad expanse of water near Conway Bridge, or *a lake at the bottom of the river*. Here the fish remain for a long time, till such time, in fact, as the spawning instincts prompt the fish to ascend the river at all hazards. "I am certain sure," Mr. Buckland adds, "that this is right, and hope eventually to see the day when angling in Conway and many other late rivers of Wales, Devon, and Cornwall is made legal in November; only no gaff must be used—only a landing-net—and all the hen-fish returned carefully and uninjured to the water." Mr. Buckland's explanation of the cause, or rather of one of the causes, which create early and late rivers is most suggestive, and seems to me to be very probable. I may mention Loch Melvin as an instance of early water; the river Ban-drows has the Lake of Melvin at its head, and the Salmon run from the sea up the river into the lake chiefly in the early spring months.

The question as to the migratory *Salmonidæ* returning to the rivers in which they were bred appears to carry evidence of an affirmatory character; experiments have proved this to be the case as a general rule; though doubtless numerous individuals perish either from exhaustion after spawning, or from the attacks of various enemies, such as Porpoises, Dog-fish, etc. Deaths from the first mentioned cause—exhaustion after spawning and the journey back to the sea—appear to be of frequent occurrence. If the parents succeed in getting down to the sea in tolerable health, they soon recruit their strength by abundance of food; but a large number are found dead every year. Buckland having examined a large number of these dead fish could find no cause of death "except an anæmic condition, and a laxity of fibre in the muscular tissue. I conclude therefore," he says, "that the natural cause of death is (except in cases of violence or wounds from fighting) simply exhaustion; most of these fish found dead are males. It is very possible that the law of nature is that the large males shall die in certain numbers, and thus leave room for the smaller males to keep up the breed. The females are found dead much more rarely than the males; these facts may also have some bearing on the interpretation of the male smolt having its milt fully developed, and capable, as I myself have proved by experiment, of fecundating the ova of adult fish. The female smolt has the ova developed in a very minute degree at the time that the male smolt contains ripe milt."—(P. 322.)

The male Salmon in the breeding season has its snout much produced, and the lower jaw is bent upwards in the form of a hook, which fits into a hollow of the upper jaw; giving the fish an unsightly appearance. As no individuals, thus sexually characterised, are found in

spring or summer-run fish, it has been supposed that this hook—sometimes an inch or more in length—has been absorbed, during the fish's sojourn in the sea. But it is more probable that these old males perish, according to the observations of several ichthyologists.

The non-feeding of the Salmon during its abode in fresh water I have already alluded to. That this is a fact I have verified myself in numerous instances; other observers have done the same. If it be asked how can muscular force be maintained for some months without food, the answer is an easy one. The Salmon lives on its own internal fat, stores of which are laid up throughout the whole body of the fish, especially in the abdominal regions, and around the pyloric cæca. Let any one compare the difference in the quality of the flesh between a sea-fed Salmon and one that has been some time in a river. In the first case the abdomen is tremulous with fatty matter, whilst the flesh of the river fish, though firm, is comparatively destitute of fat. And this continued abstinence from food is no doubt, to a considerable extent, the reason of the fish's gradual deterioration, till the exhausting process of spawning renders the Salmon now quite unfit for food. The Salmon's abode, therefore, in fresh water, should be regarded as a quasi-hybernation, during which life is maintained by stores already laid up in the organism. That muscular force may be maintained, and in fact that it is chiefly kept up by the combustion, not of the nitrogenous elements, but of the carbonaceous, has been rendered tolerably certain, and the circumstance that a Salmon may move about for a long time in fresh water without supplies of food beyond its own abundant fat, is not actually much more than a further instance of what takes place in hybernating animals, as the bear, which goes fat into winter quarters, and comes out very thin. The same may be said with regard to experiments that have been made, showing that the Swiss mountains may be ascended solely upon the strength afforded by butter and other non-nitrogenous food.

It may be objected again that the Salmon occasionally taking an artificial fly, must show that it does take natural food in the river. But a fish will sometimes seize a bait more for sport than from a desire to swallow it. What does an artificial Salmon-fly, with its glittering tinsel and gaudy colours, resemble in nature? Certainly no kind of winged insect, not even a brilliant dragon-fly, either in form or motion; no *libellula* or *agrion* ever swims in the water, least of all after the fashion in which the artificial fly is made to locomote by the angler. Sir Humphrey Davy thought "that the rising of Salmon and Sea-trout at these bright flies, as soon as they come from the sea into rivers, depends upon a sort of imperfect memory of their early smolt habits." Perhaps so, but be this as it may, the undoubted fact that the stomach and all intestinal tract are always found empty, it is a convincing proof that the Salmon, as a rule, abstains from food during its sojourn in fresh water.* I have never found anything in the stomach of a river Salmon except some whitish or yellowish mucus, and a lot of tape-worms, whose presence, according to my experience, is almost constant.

It has been shown by Siebold that sterility often occurs in the *Salmonidæ;* that some individuals are not sexually developed, and that such differ from the ordinary fish. According to Siebold this sterile state extends over the whole lifetime of the individual. It appears, however, that this sterility is merely a temporary immaturity, and that a part of the individuals arrive at a full sexual development at a later or much later period than others. Dr. Günther adds, that "many Salmonoids cease to propagate their species after a certain age, and that all so-called overgrown individuals (that is, specimens much exceeding the usual size of the species,) are barren, though they externally retain the normal specific characters."—(P. 8.)

Salmon, like the other migratory species generally, cannot be retained in fresh water for any length of time; they may live for two or three years, but do not thrive, and seem quite unable to accommodate themselves to a permanent abode in fresh water. It would seem,

* I am speaking specially of fish before spawning; as kelts they may feed. I have never examined the stomachs of kelts, but I suspect they are in too great a hurry to rush down to the sea—their natural larder—than stop to feed in the river.

however, that certain hybrids, as between the Sewen and Trout, continue to grow in fresh water.

The ova of the Salmon are capable of being impregnated by the milt of a Trout, or of some other Salmonoids, and I believe the young are hatched in due time; but from inquiries I have made, they do not thrive or live any length of time. The colouration in an adult Salmon is not subject to much variety—being different in this respect from the Sewen and Common Trout—excepting in the breeding season, when both male and female are marked with large black and red blotches; at this time the skin has become tough, and the scales are deeply imbedded therein. Mr. F. Buckland says that the skins of such fish after spawning are admirably adapted for tanning, and he advises his piscatorial friends to skin all the old kelts the water-bailiffs find dead; "when prepared these skins will make slippers, gloves, or binding for books."

Salmon grow to a large size; the following is a list of the largest Salmon in Mr. Buckland's Museum at South Kensington:—

	Weight *	Length
1.—Tay Salmon	70lbs.	4ft. 8in.
2.—Rhine Salmon	69	4 8
3.—Shannon Salmon	54	
4.—Tay Salmon, Kinfauns	53	4 0
5.—Rhine Salmon	51½	4 3
6.—Tay Salmon	51	4 3
7.—Wye Salmon	50	4 2
8.—Shannon Salmon	46	4 3
9.—Wye Salmon	44½	3 10½
10.—Tay Salmon, Kinfauns	42	3 8

Mr. Buckland draws attention to the fact that a great number of our cathedral towns stand upon rivers in which Salmon either now exist or from which they have disappeared. "When monasteries were first established, previous to cathedrals themselves being built, the founders selected sheltered spots where, for the most part, they could get a plentiful supply of fresh-water fish, especially Salmon, for the use of the table on fast-days."—(P. 341.)

Formerly Salmon were more or less abundant in the Thames; between the years 1794 and 1821, according to a record published in *Land and Water* (iii. No. 58), seven thousand three hundred and forty-six pounds weight were taken. Even now, says Günther, "almost every year Salmon and Sea-trout in the grilse state make their appearance at the mouth of the Thames (where the migratory Salmonoids have become extinct for many years) ready to ascend and to restock this river as soon as its poisoned water shall be sufficiently purified to allow them a passage."—(P. 10.)

Every one who happens to be in London in the month of November must have viewed with wonder the magnificent Salmon of many pounds weight and of bright silvery hue, exposed for sale on the slabs of the fishmongers' shops. According to our Salmon laws it is illegal to take or expose for sale any Salmon between the 2nd. of November and the 1st. of February. Of course, therefore, these must be foreign fish; they come from the Rhine, not a great way from Rotterdam. The following short account of the Rhine fisheries, given by Mr. Buckland, is interesting:—"Mr. D. Van Elst, who lives at Rotterdam, holds a lease from the government of the fisheries on the Maas, the only one of the three mouths of the Rhine through which Salmon migrate. The principal fishing station is at Orange Nassau, about fourteen miles from the sea; the river is here about nine hundred yards in width, and the nets used are about eight hundred yards long, thirty feet in depth, and the meshes two and

* Yarrell mentions a Salmon in the possession of Mr. Groves, (now Crump,) of Bond Street, London, that weighed eighty-three pounds,—this was in 1821; "flesh fine in colour, and of excellent quality."

half inches from knot to knot, or nearly ten inches in circumference. This gigantic net is worked by a steamer of twelve horse power and a windlass driven by two horses on shore; the fish are not at once killed, but are kept alive in a well-boat, which is towed to Kralingen, three miles from Rotterdam, and there sold alive to the merchants. There are five private fishing stations above Rotterdam: three are worked by steamers and horses. The nets are only worked during the ebb tide." These Rhine fish are in splendid condition, often weighing forty, fifty, and sometimes sixty pounds. The sandy tracts which compose the coast of Holland abound with Smelts and Sand-eels; even, it is said, the fields are manured with them; on these favourite fish the Salmon feed, and on these they fatten, and thus grow into the "gigantic and plump" fish which in the month of November may be seen in the London fish shops.

The female Salmon is mature when about fifteen inches long; the male, however, as we have seen, may be mature when in the smolt stage, and about six or seven inches long. The præoperculum in the Salmon has a distinct lower limb, and the angle rounded; the maxillary, which in mature specimens is slender and rather feeble, is stout and broad in young ones; it extends to a little below the posterior margin of the orbit, but in the parr state only to the middle of the eye; the head of the vomer is toothless, the single series of small teeth on the body of the vomer is at an early age lost from behind towards the front, so that half-grown and old examples have only a few (from one to four) left. The caudal fin is deeply cleft in young specimens of twenty-eight inches in length, being truncate only in very large examples during or after spawning. (See plate of male Salmon.) The hind part of the body is elongate and covered with relatively large scales, *there being constantly eleven or sometimes twelve in a transverse series* obliquely forwards to the lateral line. (See Günther, p. 13.)

A good-sized female Salmon, caught in Bala Lake on September 28th., 1878, which I had the opportunity of examining, had on its spawning-dress. Above the lateral line there were numerous large black round spots, many of which were confluent, and a number of reddish blotches or thick wavy lines; below the lateral line the colour of the sides was yellowish pink; the gill-covers were yellow below, spotted and lined with brown and red blotches; the tail square, with pale oblong pinkish brown spots; the upper part of the head was bluish with an olive tint.

Out of a number of Salmon parr or smolts caught by me on the 16th. of April, 1878, with a fly—of course I had the permission from the Severn Board of Conservators—the largest specimen measured six inches and seven tenths from end of the snout to the point of bifurcation of the tail; the smallest caught was four inches and two fifths in length. The dorsal fin of the larger example was dark clouded in the upper portion, the margin of the first ray nearly black, on the lower portion there were four or five dark spots; the pectorals were streaked longitudinally with dark lines, very dusky; the ventrals and anal nearly white; the marginal extremity of the caudal fin was dusky; the lateral line slightly descending at first, then straight to the middle of the tail; adipose fin membranous, dusky, quite free from a red tinge. Above the lateral line the whole colour of the back steel blue with purplish tinge, below lateral line silvery white; above and below the lateral line were a number of small round red spots; but these spots are variable in different individuals. In the smaller specimens the parr marks were broad and distinct; in large ones they were less apparent. The specimens of all I examined were full of insect and larval food.

If the reader would form any idea of the beautiful colour of a male Salmon in the breeding state, he should consult plate vii. in Sir William Jardine's *Illustrations of Scotch Salmonidæ.*

A Salmon in its young state, from one to two years old, is commonly called a parr, pink, smolt or smelt, and samlet; it has, however, many more names, such as brandling or brondling,

fingerling, black-tip, blue-fin, scad, shed, gravelling, last-brood, hepper, last-spring, spawn, skirling or scarling, fry; many of these however include the young of other migratory *Salmonidæ*. In some parts of Ireland, as at Lough Melvin, a Salmon parr is called a jenkins. The term grilse or Salmon-peal denotes a fish on its first return from the sea; the former word is probably a corruption of the Swedish *graelax*, "a grey lax," *i. e.* "a grey Salmon." *Kelt* applies to a Salmon, whether male or female, after spawning, but the male is also specially distinguished by the term *kipper;* the female is called *shedder* or *baggit*.

The fin-ray formula of the Salmon is

Dorsal 14.
Pectoral 14.
Ventral 9.
Anal 11.

The figure of the adult male fish is from a specimen which weighed twenty-four pounds and three quarters.

The Grilse, or young Salmon, is from a specimen weighing seven pounds.

The figure of the Parr is on the plate with the Smelt.